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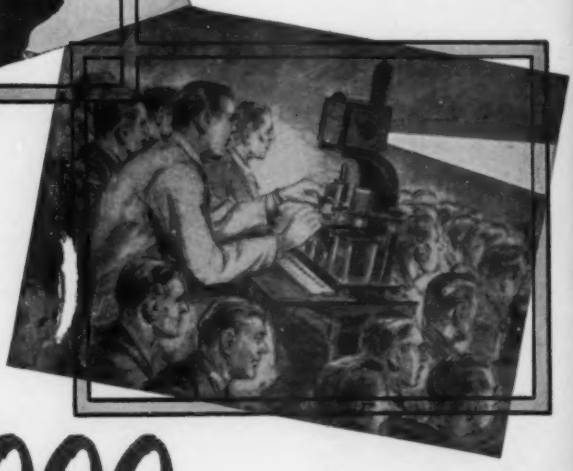
Contents

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SMALL-GROUP STUDY IN A NORMALLY LIT ROOM

The image is cast upon a screen in the dark-chamber turret at table height. Each observer (up to 10) has a separate light-excluding viewing hood. The pathologist here is discussing a slide with the surgeon; the unused hoods are easily shuttered off.



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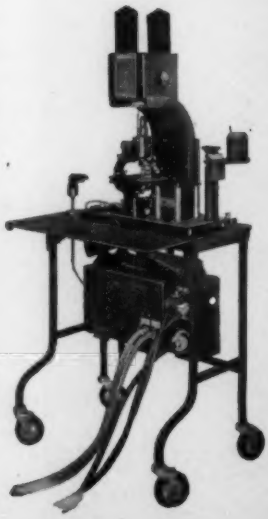

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American Institute of Chemical Engineers

Status changed from an Associated to an Affiliated Society, AAAS

THE American Institute of Chemical Engineers was formed in Philadelphia, June 22, 1908, at an organizational meeting attended by forty engineers. The original idea for the founding of the Institute came from Richard K. Meade, founder and editor of the magazine *The Chemical Engineer,* who in 1905 editorially advocated such a society and said, "The profession is now a recognized one and there are probably five hundred chemical engineers in the country." Today, forty-five years after its founding, the American Institute of Chemical Engineers has 13,500 members, a growth which has paralleled that of the chemical industry.

However, the American Institute of Chemical Engineers cannot be explained merely in numbers. In the original editorial calling for the Society, Meade said, "Membership need not be large but it should be representative of the profession. Quality and not quantity should be the motto." This idea of quality guides the A.I.Ch.E. to this day, for membership requirements make it impossible for anyone not a practicing chemical engineer to become an active voting member. Active members not only must be engaged in chemical engineering, but must also have at least eight years' experience including five years in responsible charge of important chemical engineering work.

There are three other classes of membership: Associate, Junior, and Student. Associate membership is open to chemical engineers whose experience has not yet given them enough years of responsible charge. It also includes a broad group who are qualified to cooperate in the advancement of chemical engineering. Junior membership is usually composed of recent graduates still obtaining qualifying experience, while a student member is one enrolled in a curriculum leading to a degree in chemical engineering.

The A.I.Ch.E. publishes monthly the magazine *Chemical Engineering Progress,* which in 1947 took the place of the *Transactions* founded in 1908. Other publications are the *Chemical Engineering Progress Symposium and Monograph Series,* low-cost varityped, photo-offset volumes of specialized interest to chemical engineers. The papers published in these books are also abstracted and indexed in *Chemical Engineering Progress.*

Institute meetings are usually limited to one annual meeting plus three smaller scale national meetings, held in various parts of the country. In 1954, however, there will be five meetings, for a special meeting has been called to explore nuclear engineering.

The chemical engineers have representation in other groups: the American Documentation Institute, Society of Heating and Ventilating Engineers, The American Society of Mechanical Engineers, American Society of Engineering Education, American Standards Association, Engineers' Council for Professional Development, Engineers' Joint Council, National Association of Corrosion Engineers, and others.

One of the most important functions of the American Institute of Chemical Engineers is accrediting chemical engineering education. Since 1922 it has had an active program of evaluating chemical engineering courses in colleges and accrediting those that meet its standards. There are eighty accredited curricula in chemical engineering and ninety-nine colleges with student chapters of the A.I.Ch.E.

The Institute has four major annual awards, two of which are exclusively for junior and student members: the William H. Walker Award; the Professional Progress Award in Chemical Engineering ($1000), sponsored by the Celanese Corporation of America; the Junior Member Award; and the A. McLaren White Award for the annual student contest.

The membership is represented through elected officers: president, vice president, secretary, treasurer, and twelve directors. The president of the organization for 1953 is W. T. Nichols, Monsanto Chemical Company, and the president-elect for 1954 is Chalmer G. Kirkbride, president of Houdry Process Corporation. The Society has its headquarters at 120 East 41st Street, New York City.

F. J. VAN ANTWERPEN
Editor
Chemical Engineering Progress, New York, N. Y.

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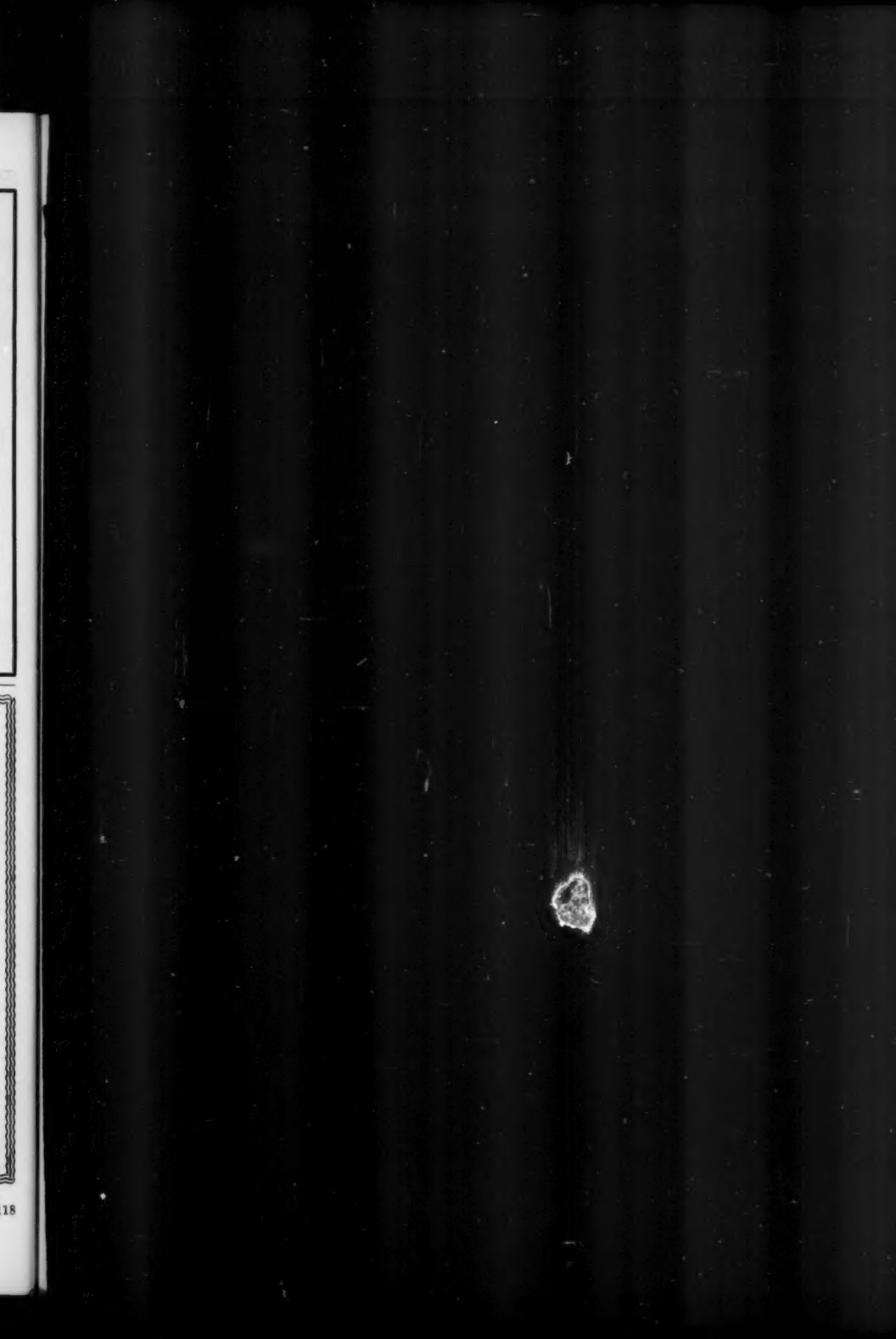

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Effects of Magnesium on Cellular Division in Bacteria[1]

M. Webb[2]

Department of Microbiology, Rutgers University, New Brunswick, New Jersey

IT HAS BECOME INCREASINGLY APPARENT during the last ten or fifteen years that the division of the bacterial cell follows a complex sequence, which, in many respects, resembles that occurring in the cellular reproduction of higher forms. It is now known, for example, that bacterial cell division entails division of the nuclear element, division of the cytoplasm, secretion of new cell wall material, and the separation of the daughter cells.

Some or all of the events of this sequence are readily thrown out of balance, or even completely inhibited. Thus bacteria, particularly the rod-shaped organisms, may be induced to elongate into filaments by various treatments which apparently inhibit cell division but which do not inhibit growth. Such an effect is produced by various chemical substances, by subbacteriostatic concentration of certain antibacterial agents, as, for example, methyl violet (*1*), sulfonamides (*2*), *m*-cresol (*3*), and penicillin (*4–6*), as well as by physical agents such as irradiation (*7–10*), or even higher temperatures of incubation (*11*).

These changes in morphology induced by chemical substances are usually temporary, since reversion to normal form occurs promptly when the filamentous bacteria are subcultured in the absence of the inhibitory agents. Irradiation, on the other hand, may give rise to a temporary (*7, 12*) or permanent (*9*) induction of filamentous cells.

From observations such as these the concept has arisen that bacterial growth, in the sense of an irreversible increase in cell substance or volume, and cell division may be considered to some extent as separate and independent processes; at least, in so far as growth may occur either with or without the operation of the cell division mechanism (*13–15*).

As pointed out by Nickerson (*16*), it is reasonable to suppose that the physiological processes resulting in the growth of microbial cells as elongated filaments are the same as the processes responsible for growth when the cells are also dividing. Thus it appears possible to investigate certain aspects of cell division by comparative studies of cells of normal morphology and the filamentous forms produced under conditions which are only partially or not at all inhibitory to growth. Such conditions as these may be realized very simply by growing bacteria in complex media deficient in ionic magnesium.

Previous studies by the present author (*17, 18*), which have been more than confirmed by the work of Nickerson (*16*), Hewitt (*19*), and Shankar and Bard (*20*), have shown that variations in the magnesium content of the culture medium may exert a marked effect upon the cell division of certain bacteria. Thus in a peptone medium rendered deficient in ionic magnesium, Gram positive[3] rod-shaped bacteria grow in the form of long filaments. These filaments, which, as shown by previously published photomicrographs (*17, 18*), frequently appear to possess diameters significantly less than those of the original rods, revert to cells of normal morphology when subcultured in the same medium supplemented with suitable amounts of magnesium (*17, 18*). Other metals, with the possible exception of divalent manganese, cannot overcome the adverse effects of magnesium deficiency on the cell division process (*21*). Indeed, the formation of filaments in a magnesium-deficient medium is enhanced by the addition of certain divalent metallic ions such as zinc and cobalt (*16, 21*). This may result either from competitive ion antagonism, as described by McLeod and Snell (*22*), between the zinc or cobalt ions and the residual magnesium present in the medium, or represent an additional inhibition of the cell division processes through the inactivation of essential sulfhydryl groups (*23*).

Inhibition of cell division in cultures of the Gram positive rod-shaped bacteria occurs not only in peptone media deficient in magnesium but also in these complex nutrient solutions when supplemented with excessive amounts of this ion. This latter effect has a parallel in the fact that certain enzymes which are activated by metallic ions at low concentrations are inhibited by the same ions at higher concentrations.

[1] Based on a lecture given before the Theobald Smith Society, Summit, N. J., April 9, 1953.

[2] Special fellow of the National Institute of Microbiology, National Institutes of Health, and visiting fellow in Microbiology, Rutgers University. On leave of absence from the Strangeways Research Laboratory, Cambridge, England.

[3] The terms "Gram positive" and "Gram negative" refer to the behavior of heat-fixed smears of bacterial cells to the conventional Gram-staining procedure. The so-called Gram positive bacteria retain the initial basic dye when mordanted and treated with neutral solvents such as ethanol or acetone, whereas the Gram negative organisms are decolorized under these conditions and are subsequently stained with a second dye of contrasting color.

Cytological examination of the filamentous cells, according to the procedures developed by Robinow (*24*) and others, shows that it is the final stages of cell division (i.e., the formation of transverse plasma membranes and/or cross cell walls) that fail to occur in bacteria grown in media deficient in, or containing excessive amounts of, magnesium, whereas division of the nuclear elements appears unaffected.

Cell division of Gram negative rod-shaped bacteria in peptone media, while inhibited by excessive amounts of magnesium, is unaffected by reduction in the magnesium concentration. One contributory factor to this marked difference in the behavior of the Gram positive and Gram negative rods is possibly related to the fact that the former accumulate magnesium during growth and incorporate it as an essential component in the structure of the "Gram complex" (*25*).

The difference between the amounts of magnesium necessary to support optimal growth of Gram positive and Gram negative bacteria is particularly apparent when the bacteria are cultivated in very simple chemically defined media composed only of inorganic salts and suitable single sources of carbon and nitrogen (*26*). In the absence of magnesium, these nutrient solutions are unable to support bacterial growth. With increasing concentrations of magnesium, the amount of growth increases to a maximum and then tends to decrease. Moreover, it is readily apparent from a study of the growth of a number of different bacterial species in such simple media that the concentration of magnesium necessary to support optimal growth of Gram positive bacteria, some 20–40 parts per million (ppm), is about ten times greater than that required by the Gram negative organisms under the same conditions.

In these simple chemically defined solutions, where, in contrast to the effects observed in peptone media, suboptimal amounts of magnesium predominantly inhibit bacterial growth, low concentrations of magnesium do not induce the formation of filaments in cultures of the Gram positive bacilli. In fact, under these conditions cell division is normal throughout the restricted populations that the media are able to maintain.

The concentration of magnesium necessary to support maximum growth in simple chemically defined media is reduced markedly by the addition of amino acids, and even for Gram positive bacilli may become as low as 2–3 ppm if complex mixtures of amino acids and growth factors are added (*27*).[4] Under these conditions, further increases in the magnesium concentration (to 100 ppm) are without effect upon the amount of growth.

The differences observed between the magnesium requirements of Gram positive and Gram negative bacteria for growth in the simple synthetic media are also apparent in these complex chemically defined solutions. Thus, although the relationship between growth and magnesium concentration is, of course, dependent upon the organic composition of the medium, in general Gram positive bacteria fail to grow when the magnesium content is less than .6 ppm, whereas this concentration is almost sufficient to maintain maximum growth of Gram negative species (*27*).

In these complex chemically defined solutions the magnesium requirements for cell division in cultures of the Gram positive rods are higher than for growth. Thus, in solutions containing low concentrations of magnesium (i.e., 1–6 ppm), as in peptone media, the cell division of the Gram positive rod-shaped bacteria is inhibited. The cells grow in the form of long filaments, which, when subcultured in the same medium containing increasing amounts of magnesium, change in appearance from filaments to chains and thence to isolated rods of normal morphology. However, under the same conditions, no significant changes are observed in the morphology of Gram negative rod-shaped bacteria. As it has been shown that a deficiency of ionic magnesium restricts the growth of other microorganisms such as yeasts (*16*), actinomycetes, *Polytomella*, and algae (*28*) to a greater or lesser degree, but has little or no effect upon their morphology, the inhibitory effects of magnesium deficiency upon cell division appear to be confined to the Gram positive rod-shaped bacteria. As it is unlikely that the Gram positive and Gram negative rod-shaped bacteria divide by essentially different mechanisms, or that magnesium is essential for the cell division of the former, but not of the latter, the difference in response of the Gram positive and Gram negative bacteria to reduced amounts of magnesium becomes of particular interest. From the foregoing considerations it appears that the formation of filaments in magnesium-deficient cultures of the Gram positive organisms is not due to a direct inhibition of the cell division mechanism, but is an indirect result of the inhibition of certain assimilatory or metabolic reactions. No evidence has been obtained throughout this work that the formation of filamentous cells in the magnesium-deficient cultures is due to the accumulation of products arising from partially inhibited, or altered metabolism, which are themselves inhibitory to cell division (*28*). However, through the application of the analytical techniques developed by Davidson and Leslie (*29*) in their biochemical studies on the growth and development of avian cells in tissue culture, it has been possible to show that the growth of Gram positive bacteria in magnesium-deficient media is accompanied by a decrease in the rates of amino acid assimilation and protein synthesis relative to the rates of synthesis of other cellular constituents.

The basis of the investigations of Davidson and Leslie is the experimental finding of a constant average value for the deoxyribonucleic acid content of the interphase cell nuclei in all somatic tissues of any one animal species (*30, 31*). This provides a chemical unit which can be used both as a measure of cell multiplication and as a standard of reference by which changes in the relative amounts of other cell constitu-

[4] Details of the procedures adopted to eliminate magnesium and other trace metals from the organic constituents of the complex chemically defined nutrient solutions are recorded in the paper cited in reference 27.

ents may be determined (*29*). Recent investigations have shown that the cells of a given bacterial species in the stationary (resting) state, in common with the interphase cells of plant and animal tissues contain a constant amount of deoxyribonucleic acid (*32–34*; see also Table 1). Furthermore, determinations of the average content of deoxyribonucleic acid per cell in cultures of *Escherichia coli* (*32*) and *Clostridium welchii* (Fig. 1) throughout the growth cycle show that the deoxyribonucleic acid content increases during the lag phase to approximately twice its initial value. This maximum is reached at the transition between the lag and log phases, just before the onset of cell division. Once active multiplication is established, the average deoxyribonucleic acid content of the cells from growing cultures does not vary greatly from that of the resting cells. Thus it is obviously possible to use the deoxyribonucleic acid content of the normal bacterial cell as a standard of reference in growth and metabolic studies.

The average deoxyribonucleic acid content of filamentous cells harvested at the end of growth from cultures of the Gram positive rod-shaped bacteria in peptone media deficient in magnesium shows a considerable variation when each filament is counted as a single cell (Table 1). The magnitude of this variation is dependent upon the mean length of the filaments. However, when each filament is counted as the equivalent number of normal cells, a value is obtained for the average deoxyribonucleic acid content of the "unit cell" which is independent of filament length. Furthermore, if allowance is made for inaccuracies associated with the visual estimation of the number of unit cells per filament, there is close agreement between the values found for the deoxyribonucleic acid content of the normal cells in the stationary state, and that of the unit cell of the filamentous forms (Table 1). This relationship, which has been shown to be of general application, is similar to that found by Caldwell and

TABLE 1

DEOXYRIBONUCLEIC ACID PHOSPHORUS (DNA P) CONTENT OF THE NORMAL AND FILAMENTOUS FORMS OF *Cl. welchii*

Normal cells	Filaments*	
mg DNA P/cell ($\times 10^{12}$)	mg DNA P/filament ($\times 10^{12}$)	mg DNA P/unit cell ($\times 10^{12}$)
2.29	6.60	2.24
2.21	6.26	2.05
2.14	15.0	2.73
2.50	21.4	2.60
2.27	28.4	2.69
2.40	7.5	2.06
2.44	26.7	2.40
2.30	7.10	2.11
Mean = 2.32	Mean = 2.36	

* The filamentous cells were harvested from 16–18 hr cultures incubated at 37° in a magnesium-deficient peptone medium, the cells of normal morphology from cultures of similar age in the same medium supplemented with 0.015% $MgSO_4 \cdot 7H_2O$.

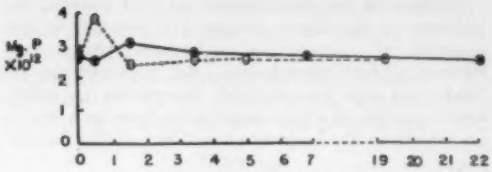

FIG. 1. Variation with the age of the culture of the average deoxypentose nucleic acid content per cell (or unit cell) of *Clostridium welchii*. Solid line, magnesium-deficient (filamentous) culture. Dotted line, control cultures containing 0.015% $MgSO_4 \cdot 7H_2O$.

Hinshelwood (*34*) for the filamentous cells induced in cultures of *Aerobacter aerogenes* by the presence of *m*-cresol. Moreover, on the assumption that all the deoxyribonucleic acid of the bacterial cell is located in the nucleus (or its equivalent), as suggested by Boivin (*35–37*), the results of the chemical analyses (Table 1) are in accordance with the cytological evidence which, as mentioned above, shows that the conditions of magnesium deficiency leading to an inhibition of cytoplasmic division are without effect upon the division of the nuclear structures. It must be emphasized, however, that without supplementary cytological evidence, it would be unjustified to claim that the values presented in Table 1 represent the average deoxyribonucleic acid content of the nuclear element of the resting *Cl. welchii* cell.

The curves (Fig. 1), showing the variation during growth of the average content of deoxyribonucleic acid in normal cells and the unit cells of the filamentous forms of *Cl. welchii*, are closely similar. Thus, both show an initial increase in deoxyribonucleic acid content to a maximum at the end of the lag phase. The fact that the deoxyribonucleic acid content of the unit cell in the filamentous cultures, where the lag phase is somewhat prolonged, does not increase to the same extent as does the deoxyribonucleic acid content of the normal cells is probably due to the decreased rate of growth (i.e., rate of increase in dry weight) of *Cl. welchii* in the magnesium-deficient medium.

With the constant deoxyribonucleic acid content of the resting cell or unit cell as a standard of reference, attempts have been made to determine changes in the relative amounts of other components of the bacterial cell as a result of growth in magnesium-deficient peptone media. In these experiments media of three different magnesium contents have been used. The first of these, the deficient medium (medium 1), was prepared from a concentrated aqueous solution of the peptone rendered deficient in magnesium by treatment with ammonium hydroxide in the presence of free phosphate ions in the normal way (*17*), whereas the second and third (media 2 and 3) consisted of medium 1 supplemented with 4 ppm and 15 ppm magnesium, respectively. Cells harvested at the end of growth in these nutrient solutions were submitted to extensive chemical analysis. The results of these determinations, full details of which will be published elsewhere, may be summarized as follows.

Relative to the deoxyribonucleic acid content, no uniform or significant changes are detected in the amounts of intracellular acid-soluble phosphorus, ribonucleic acid phosphorus, total carbohydrate, or total lipid and phospholipid phosphorus in either Gram positive or Gram negative bacteria as a result of growth in the magnesium-deficient media (media 1 and 2).

In Gram positive rod-shaped bacteria harvested at the end of growth in medium 2, where the concentration of magnesium is intermediate between that required for the growth of the organisms as long thin filaments and that necessary for the growth of cells of normal morphology and leads to the development of populations consisting mainly of chains of normal-sized cells together with some short filaments, the relative amounts per unit cell of both acid-soluble nitrogen and protein nitrogen are significantly less than the corresponding values found for cells grown in medium 3.

The relative amounts per unit cell of acid-soluble nitrogen and protein nitrogen of the abnormal, long, thin, filamentous forms of the Gram positive rods harvested from the magnesium-deficient medium (medium 1) are greater than those of cells grown in the medium containing intermediate concentrations of magnesium (medium 2) and may even approximate the values found for cells grown in the presence of adequate amounts of magnesium (medium 3). These results are in accordance with those of Nickerson and Sherman (*38*), who found little or no difference between the ribonucleic acid and protein nitrogen contents expressed as a percentage of the dry weight, of the normal and magnesium-deficient, filamentous forms of *B. cereus*.

With the Gram positive micrococci, where, in general, reduction in the magnesium content of the medium predominantly inhibits growth and has no effect upon the morphology of the cells, growth in medium 1 effects an even greater reduction in the relative amounts per cell of acid-soluble nitrogen and protein nitrogen than does growth in medium 2.

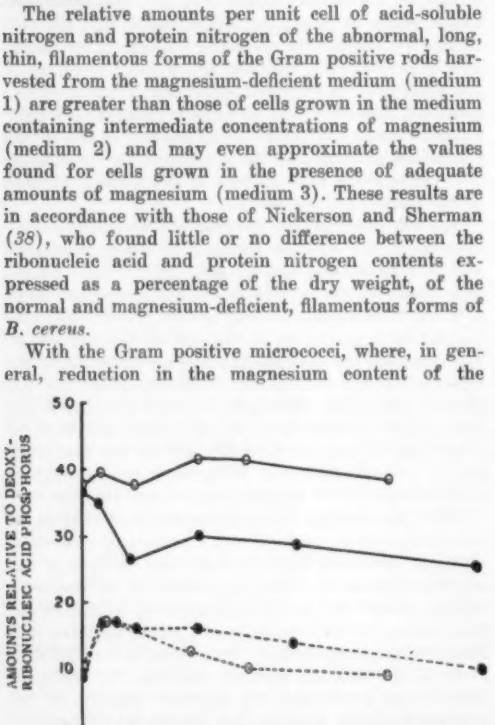

FIG. 2. Effect of magnesium on the variation with the age of the culture of the relative contents of protein nitrogen (solid line) and ribonucleic acid phosphorus (dotted line) in *Clostridium welchii* cells grown in a peptone medium deficient in magnesium. Shaded circles refer to culture grown in the absence of additional magnesium; open circles to cultures grown in the deficient medium supplemented with 0.015% $MgSO_4 \cdot 7H_2O$.

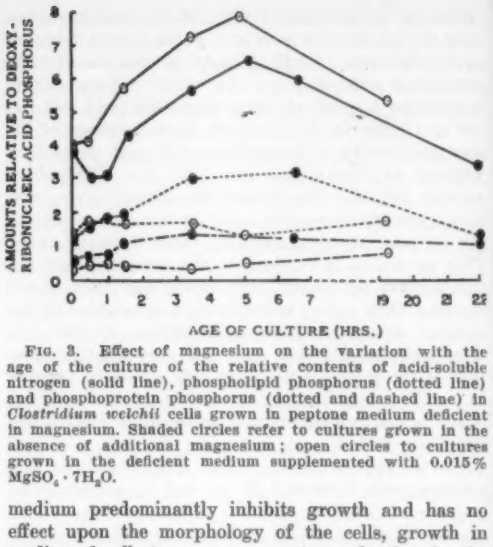

FIG. 3. Effect of magnesium on the variation with the age of the culture of the relative contents of acid-soluble nitrogen (solid line), phospholipid phosphorus (dotted line) and phosphoprotein phosphorus (dotted and dashed line) in *Clostridium welchii* cells grown in peptone medium deficient in magnesium. Shaded circles refer to cultures grown in the absence of additional magnesium; open circles to cultures grown in the deficient medium supplemented with 0.015% $MgSO_4 \cdot 7H_2O$.

With Gram negative bacteria no significant differences are found between the contents of acid-soluble and protein nitrogen in cells harvested from either medium 1, medium 2, or medium 3.

The results discussed above have been obtained with cells harvested at the end of growth, i.e., from cultures in the stationary state. However, throughout the growth of the Gram positive rods there is a marked reduction in the acid-soluble nitrogen and protein nitrogen contents of the cells as a result of growth in the magnesium-deficient medium. This is illustrated by the results presented in Figs. 2 and 3, which show the variation in relative amounts of certain cell constituents during the growth of heavy inocula of *Cl. welchii* (derived from an overnight culture in medium 3) in media 3 and 2.

There appears little doubt, therefore, that an inadequate supply of ionic magnesium in the culture medium adversely affects certain aspects of the nitrogen metabolism of Gram positive bacteria. Furthermore, the analytical results reveal not only that the changes induced in the relative contents of protein nitrogen and acid-soluble nitrogen of the Gram positive rods in magnesium-deficient media are diminished when growth occurs in the form of filaments, but also that there is an essential difference between the effects of magnesium deficiency on the chemical composition of Gram positive and Gram negative bacteria.

Thus, although the mechanism by which the cell division processes are held in check to permit growth in the form of filaments is still unknown, it now appears possible to advance certain tentative suggestions which may explain the formation of these abnormal cells in magnesium-deficient cultures. For ex-

ample, it has been shown by Gale and his colleagues that the Gram positive and Gram negative bacteria differ markedly in their amino acid metabolism (*39–41*). Thus, it has been established that Gram positive bacteria assimilate preformed amino acids from the external medium and concentrate them within the cell (*40*). Gram negative bacteria, however, do not effect this internal concentration. The amino acids which accumulate within the Gram positive cell form a reservoir for protein synthesis and for other metabolic processes. The assimilation of glutamic acid (and, presumably, certain other amino acids which enter the cell by an "activation" process) by Gram positive cells (*Staph. aureus*) requires a source of energy, which may be supplied by the exogenous metabolism of glucose, and either magnesium or manganese, or both (*42*). It is now known from the work of Nickerson and Sherman (*38*) that although no significant difference can be detected between the rates of endogenous respiration of the normal and magnesium-deficient filamentous forms of *B. cereus*, the oxidation of added substrate (e.g., glucose, pyruvate, alanine, or glutamate) by the filamentous cells proceeds at rates only 1/3 to 1/6 of those exhibited by the cells with uninhibited division mechanisms.

It seems possible, therefore, that a reduction in the magnesium content of complex nutrient solutions containing preformed amino acids may lead to a reduction in the rate of amino acid assimilation and a consequent decrease in concentration of amino acids within the cell. This decrease in the internal amino acid concentration, reflected in the analytical determinations by a reduction in the content of acid-soluble nitrogen, would result, in turn, in a decrease in the rate of protein synthesis. A decrease in the rate of protein synthesis, relative to the rates of synthesis of other cellular components, would lead to the reduction in the relative protein content of the cell shown by chemical analysis. The maintenance of certain proteins, at least, at a critical level must be essential for the growth of the cell. Thus, unless the bacterium can increase its rate of protein synthesis by increasing the rate of assimilation of amino acids, the growth of the culture is inhibited. With the Gram positive rod-shaped bacteria the formation of long filamentous cells appears in some way to provide a means of overcoming the effects of magnesium deficiency on amino acid assimilation and protein synthesis. Moreover, from such considerations it is possible to account not only for the production of the filamentous forms of the Gram positive rods and the inhibition of the growth of the Gram positive cocci in magnesium-deficient complex media, but also to offer an explanation for the fact that in simple chemically defined solutions, where the essential amino acid components of the cellular protein constituents are not assimilated directly, but are built up from the components of the medium, a deficiency of magnesium predominantly inhibits growth and is without effect upon the morphology of the Gram positive rods.

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The Concentration of Contaminant Alkali Salts in Ground Level Air[1]

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KNOWLEDGE of the concentration of alkali salts in ground level air[2] is of great interest to chemists and physicists in connection with problems of atmospheric corrosion (*1–3*) and in connection with background effects in spectroscopic work (*4*). Studies of salt concentrations in air appear to have been made principally by meteorologists interested in nucleation phenomena and by the various investigators concerned with the causes and the effects of atmospheric pollution (*5*). Since many of these papers appear in publications not usually consulted by, or readily available to most chemists and physicists, we have thought it worth while to summarize here for ready reference the results of our literature survey of this topic. No claim is made for complete coverage; it is believed, however, that our results and data form a representative cross section of present knowledge.

The possible origin of nuclei of all types in ground level air has been discussed in detail by Landsberg (*6*)

[1] This work was supported by the Bureau of Ordnance, Department of the Navy.

[2] The term "ground level air" as used in this paper refers to the part of the troposphere that extends from sea level to about 2000 meters.

TABLE 1

CONCENTRATION OF ALKALI HALIDES IN GROUND LEVEL AIR
Coastal Sites*

Location	Number of determinations	Period of observation	Average of reported concentrations	$Na/cm^3 \times 10^{-11}$	Reference
Roche Douvres, France	1	3 days	0.00462 g Cl/341 l	2200	25
North Sea, Germany	?	?	0.9 mg NaCl/100 l	900	19
Mogadiscio, It. Somaliland	3	3 days	54.3 mg Cl/l H_2O†	170	1
Eupatoria, USSR	*ca.* 250	2 mos	823 μg NaCl/m^3	84	13–14
Pompano, Fla.	4	1 day	600 μμg NaCl/cm^3	62	28
La Jolla, Calif.	23	2 mos	0.228 mg Cl/m^3	39	15–17
Venice, Italy	13	13 days	0.125 mg Cl/m^3	21	24
Bermuda	7‡	1 day	20.1 g Cl/$cm^3 \times 10^{12}$	3.4	26
Woods Hole, Mass.	7‡	6 days	13.8 g Cl/$cm^3 \times 10^{12}$	2.5	26
	3	1 day	8.9 g Cl/$cm^3 \times 10^{12}$	1.6	29
Beaufort Harbor, N. C.	12	8 days	72.201 mg salt/dm^3‖	1.7	22
Brunswick Co., N. C.	?	?	2.3 mg salt/dm^3#	0.5	23

* Arranged in order of decreasing concentration.
† Air at 82% relative humidity and 25° C.
‡ This data was obtained at altitudes from 15–1200 m.
§ Values for altitudes up to 4 m.
‖ Wind velocity, 13.4 mi/hr.
Wind velocity, 5 km/hr.

TABLE 2

CONCENTRATION OF ALKALI HALIDES IN GROUND LEVEL AIR
Inland Sites*

Location	Distance inland, km	Number of determinations	Period of observation	Average of reported concentration	$Na/cm^3 \times 10^{-11}$	Reference
Tokyo, Japan	10	†	12 mos	4.4 μg Cl/m^3	0.7	9
Tokyo, Japan	10	†	12 mos	7.6 μg Cl/m^3	1.3	10
Los Angeles, Calif.	24	†	†	0.01 ppm NaCl	1	5
Chion-ji, Japan	30	14	13 days	7.3 μg Cl/m^3	1.2	20
Pt. Grey, B. C.	30	30	3 mos	3.75 mg NaCl/1000 m^3	0.4	2
Pavia, Italy	95	10	?	0.016 mg Cl/m^3	2.7	11
Pavia, Italy	95	21	14 mos	0.0194 mg Cl/m^3	3.2	12

* Arranged in order of increasing distance from the sea.
† An unspecified number of determinations were carried out over a period of at least a year.

FIG. 1. A map showing the approximate location of the test sites listed in Tables 1 and 2.

and Neuberger (*7, 8*). The more abundant nuclei in the air are of terrestrial origin[3] and are believed to arise primarily from volcanic activity, radioactive emanations, forest fires, domestic and industrial combustion effluents including motor vehicle exhaust gases, and the action of the wind in sweeping up and carrying along such particulate matter as soil, dust, bacteria, and pollens. The more specific origin of the alkali salts in air is to be found principally in oceanic salts carried inland by the action of the wind and in the manifold combustion products issuing into the air.

A wide variation in the concentration of nuclei in air has been shown to exist. It is perhaps obvious that the location of the test site, the previous history of an ambient air mass, and transient local phenomena will contribute to this variation. The data presented below (Tables 1 and 2) show, for instance, that the concentration of sodium chloride in ground level air is generally higher at coastal sites than at inland test stations. The detailed effects of meteorological conditions on the concentration of nuclei have not been established as yet with certainty. There is, however, some evidence that the chloride concentration increases with increasing wind velocity (*9*) and decreases with increasing humidity (*10*).

To determine the concentration of alkali halides in air, a measured volume of air is usually bubbled through chloride-free water (*9–24*) or passed through a suitable filter from which the suspended matter can be leached with chloride-free water (*2, 25*). The chloride content of the water is then determined by titration with silver nitrate. A less common "isopiestic" method has been employed by Woodcock (*3, 26–29*). Droplets and particulate matter from air were collected on glass plates which were then placed in a controlled humidity chamber where the change in drop diameter with change in humidity could be observed with the aid of a microscope. The chloride ion concentration on the plates was then estimated by means of graphs constructed from data on concentrated sea water with known chloride concentration.

It has been tacitly assumed by some workers in this field that the concentration of sodium ions is equal to that of the experimentally determined chloride ions and they have therefore reported their results directly in terms of sodium chloride concentrations. The accuracy of this procedure, however, is open to some question in view of the recent work of Sugawara *et al.* (*30–32*) and Mijake (*33*). These workers found from an analysis of the rain water in a light rain falling near a large body of salt water that the ratio of sodium to chloride ions was approximately equal to that found in sea water ($[Na^+]/[Cl^-] = 0.85$). They furthermore found that this ratio varied from 0.48 to 2.43 when other types of condensation such as mountain fog, sea fog, rime, inland rain, or heavy rainstorms were being considered. It is evident from these examples that the concentrations of sodium ions reported on the basis of a 1:1 equivalence with the experimentally determined chloride ions (as has been done for most of the data in Tables 1 and 2) are subject to some error. The values obtained in this manner are, however, probably accurate to within an order of magnitude.[4]

[3] Nuclei of extraterrestrial origin are believed to contribute only a very small fraction to the total number observed.

[4] Some direct determinations of sodium in the air have been carried out recently. In the smog studies in Los Angeles (*5*), the precipitate collected in a Westinghouse Precipitron was analyzed for sodium salts by flame photometry. Photoelectric counting techniques for sodium in airborne nuclei have also been described recently by Soudain (*34*) and by Vonnegut and Neubauer (*35*).

As far as the authors are aware, data on the concentration of alkali salts in ground level air are available from 16 different sites. The 15 investigators engaged in these studies have made a total of some 500 individual determinations. The data obtained in these studies are presented in Tables 1 and 2, which refer to coastal and inland sites, respectively. For convenience in the application of these results to background effects in flame spectroscopy (*4*), the data have been converted to common units of sodium atoms/cm^3 (Na/cm^3) under the assumption that $[Na^+]/[Cl^-] = 1$. The overall average of Na/cm^3 found for the various inland sites, is 1.5×10^{11} sodium atoms/cm^3.

The locations of the sites mentioned in Tables 1 and 2 are shown in the accompanying map (Fig. 1). It may be noted that these sites form a representative sample of test locations in the northern temperate zone.

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Some Carbohydrate Components of Reticular Fibers[1]

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OVER HALF A CENTURY AGO, Mall (*1*) showed that connective tissue contains translucent netlike "reticular fibers," as distinct from the white bundles of collagenous fibers; and Siegfried (*2*) isolated from reticular fibers a material which he called "reticulin." A few years later, histologists showed that in sections of various tissues treated by the silver method of Bielschowsky, reticular fibers stain black,[2] while collagenous fibers stain light brown (*3–7*). This has remained the only universally accepted criterion for the distinction between these fibers. There were either no or negligible differences when the two types of fibers were compared by the usual staining techniques (*8*), by chemical methods of analysis (*9*), or by the techniques of electron microscopy (*10–12*) and x-ray diffraction (*13–15*).

There is a widespread opinion that even the result obtained with the silver method does not reflect true chemical differences between the two types of fibers. Instead, it is attributed to a physical effect related to fiber diameter, with the smaller reticular fibers presenting a greater surface for the precipitation of silver than the larger collagenous fibers, and thus appearing black instead of light brown (*8, 16*).

However, the fact that the periodic acid-Schiff technique stains reticular fibers intensely (*17, 18*) and collagenous fibers only faintly (*18*) suggested the existence of some chemical differences. The evidence accumulated by the work of several investigators (*19–21*) indicates that in routine histological sections, the periodic acid-Schiff technique detects 1,2-glycol and α-amino alcohol groups (which are oxidized by periodic acid to yield aldehyde groups which

[1] This work was supported by a grant from the National Cancer Institute of Canada. The cattle tissues were obtained with the kind cooperation of H. Nadeau and G. McDavid of Canada Packers, Ltd. The Permutit Q was a gift from the Permutit Company.

[2] For convenience, the term "reticular fibers" is used in the present work to include fibers as well as the membranous structures stained by the silver method: basement membrane, membrana propria, reticulum. Rühle (*34*) and many others feel that these membranes are composed of reticular fibers.

in turn react with the Schiff reagent); and furthermore, that these reactive groups occur mainly within tissue carbohydrates. Thus, the two types of fibers would differ qualitatively or quantitatively in their carbohydrate components.

In the present work, the presence of carbohydrate components in reticular and collagenous fibers was investigated by paper chromatography. The results provided a basis for a chemical distinction between the two types of fibers.

On examination of a series of cattle tissues stained by the silver method (*7*), it was found that lymph node, lung, testis, and adipose tissue (perirenal fat) contained an abundance of reticular and some collagenous fibers. These tissues were, therefore, selected for carbohydrate analysis. Achilles tendon was used as a source of collagenous fibers since it contained almost exclusively this type of fiber, although small amounts of reticular fibers are also present (*22*).

The techniques used were not devised to separate "reticulin" and "collagen" chemically, but rather to obtain whatever reticular and collagenous fibers there were in the organ as cell-free as possible. Treatment with acids, alkalis, or enzymes, was avoided since these agents might cause destruction of some of the components.

The organs and tissues were stripped of their capsules and adhering material. Large blood vessels were excised. The lymph nodes, lungs, testes, and tendons were cut into small pieces and repeatedly pressed in a Latapie plastic squeezer and washed with large volumes of cold running water to remove cells and soluble materials. They were then washed with distilled water, dehydrated with alcohol, fat extracted with boiling acetone, washed in ether, and dried. The adipose tissue was subjected only to fat extraction, ether washing, and drying. The residues obtained after extraction of lymph node, lung, testis, and adipose tissue mainly consisted of reticular fibers and membranes, with a fair amount of collagenous fibers, and are referred to as reticular materials. In contrast, the residue from the extraction of tendon consisted essentially of collagenous fibers and is referred to as collagenous material.

The hydrolysis of these materials was catalyzed by the hydrogen form of a polystyrene sulfonic acid resin, Permutit Q (*23*). The resin was pretreated with 4.4*N* hydrochloric acid (900 ml of acid per liter of resin), washed with distilled water until the washings were neutral and free from chloride ions, and air-dried. Two hundred milligrams of each of the materials prepared, 2.4 g of resin, and 5 ml of water were heated in sealed glass tubes in an oven at 100° for 48 hours. The liquid was decanted, the resin was washed twice in the tube with 2-ml portions of water, the solutions were combined and filtered. The filtrate was evaporated to dryness *in vacuo* at 40°C, and the residue was dissolved in 0.1 ml water. The solution was analyzed by unidimensional ascending paper chromatography, using rectangular sheets of Whatman No. 1 ashless paper, 27 cm wide by 38 cm high. Three λ of each of the solutions were placed at individual points of origin located on a line drawn at 4 cm from one of the narrow edges of the paper. For comparison, 3 λ of a solution which contained 1% of each one of the following sugars, galactose, glucose, mannose, fucose, and ribose were also placed on the line as a marker. The paper was fashioned into a cylinder by stapling the long edges together, developed three times (*24*) in a butanol: pyridine: water solvent (*25*), and sprayed with the aniline hydrogen oxalate reagent (*26*). Simple sugars, and hexuronic acids, but not hexosamines, can be recovered and detected by this method of hydrolysis and chromatography.

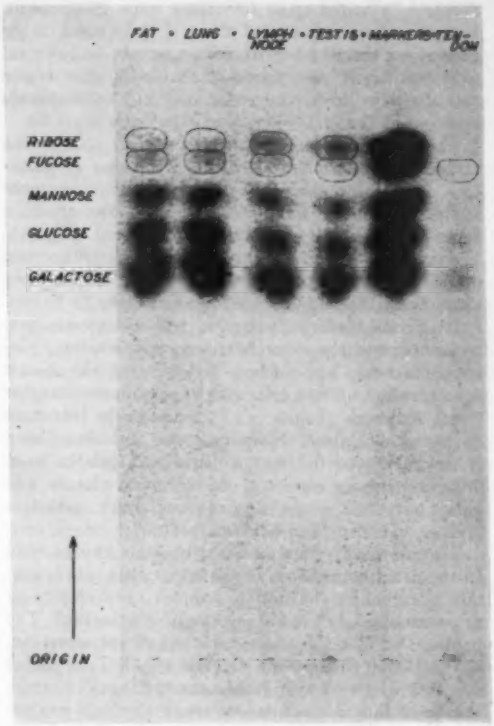

FIG. 1. Paper chromatogram. The markers indicate the location of the galactose, glucose, and mannose spots, while the fucose and ribose spots, which on the paper could be easily distinguished by their greenish and reddish color, respectively, appear fused on the photograph. The positions of the weak fucose and ribose spots in hydrolyzed materials are outlined.

On the left of the markers, hydrolyzates of various organ preparations rich in reticular fibers show the presence of large amounts of galactose, glucose, and mannose and small amounts of fucose and ribose. On the right of the markers, a hydrolyzate of a tendon preparation rich in collagenous fibers shows the presence of traces of galactose, glucose, mannose, and fucose.

The reticular materials (Fig. 1) gave rise to intense reddish-brown spots for galactose, glucose, and mannose and a less intense greenish-brown spot for

fucose.[3] Faint red spots for ribose were also present, but since the intensity of these spots seemed to be related to the number of cells seen on histological examination of the reticular materials, the ribose was attributed to cellular contamination. No hexuronic acids were found.

The chromatogram from 200 mg of collagenous material (tendon) also showed the presence of galactose, glucose, mannose, and fucose. However, the spots were much less intense than those obtained from the same weight of reticular material (Fig. 1). Even when five times this amount of collagenous material was used, the spots were still fainter than those from 200 mg of reticular material.

It is concluded that reticular and collagenous materials contain the same four sugars—galactose, glucose, mannose, and fucose—but in a much greater concentration in reticular than in collagenous material. Although no data can be found in the literature on the carbohydrate components of reticular fibers, it has been reported that collagen and gelatin from different sources contained 0.5 per cent glucose and galactose (*27, 28*) and in more recent work, galactose glucose, mannose, and hexosamine (*29*).

The presence of galactose, glucose, mannose, and fucose in reticular fibers suggests that these fibers contain a carbohydrate-protein complex, probably their characteristic chemical component, "reticulin." The presence of a much smaller amount of the same carbohydrates in collagenous material may be interpreted in either of two ways. Either the "collagen" characteristic of this material is also a carbohydrate-protein complex with a much lower content of carbohydrates than "reticulin" or it is a protein contaminated with reticulin due to the presence of some reticular fibers within all types of connective tissue (*30, 31*), even tendon (*22*).

Accordingly, the pronounced staining of reticular fibers and membranes by the periodic acid-Schiff technique is explained by their high content of carbohydrate, while the slight staining of collagenous fibers by this technique is due to the small amount of carbohydrate which is either incorporated in, or a contaminant of, collagen. The same explanation may account for the results of the silver stain since at least in its later modifications, it includes—like the periodic acid-Schiff technique—the successive action of an oxidizing agent (potassium permanganate [*6, 7*] or periodic acid [*32, 33*]) and an aldehyde reagent (ammoniacal silver nitrate).[4]

In conclusion, carbohydrates are present in large amounts in "reticulin" and in small amounts (possibly as a contaminant) in "collagen." These findings satisfactorily explain some of the staining properties of reticular and collagenous fibers.

[3] Control experiments revealed that fucose is partly destroyed by heating with the resin; therefore, a larger amount may be present than appears from the chromatograms.

[4] It is probable that the two types of fibers have a similar protein moiety (*9–15*). This might explain why histological techniques other than the silver method and periodic acid-Schiff technique stain them in the same manner (*8*).

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Fact without theory is chaos. Theory without fact is fantasy.

C. O. WHITMAN

News and Notes

The American Society for Horticultural Science

THE American Society for Horticultural Science celebrated its fiftieth anniversary at the annual meeting held at Madison, Wisconsin, September 7–9. On September 9, 1903, 30 men met in the library of the Massachusetts Horticultural Society in Boston to approve the constitution and bylaws of the new society. On September 9, 1953, over 400 people were registered for the annual meeting, and the membership of the society had already passed the 1700 mark. This figure includes 200 members from 44 foreign countries. International recognition is a source of satisfaction, not merely from the organizational viewpoint, but as the slight contribution of American horticulture to the stockpile of international goodwill which science, art, and education continuously manufacture as a welcome by-product.

The original and continuing purpose of the society is to set up more scientific standards for the profession, to facilitate the publication of scientific findings, and to provide a common ground as well as a common meeting place for members of the profession. The status of horticulture at the beginning of the century required some such move. Even a rapid perusal of the horticultural literature of that period reveals a curious mixture of field notes, random observations, and grower experiences intermingled with reports of simple but effective experiments. According to Liberty Hyde Bailey, the first president of the Society, "There was (in 1903) no meeting ground within the framework of state or local horticultural societies for the scientist. This society was formed of necessity."

The success of the undertaking, is shown by the fact that this organization is now the largest society of professional horticulturists in the world. It is subdivided into five regional groups, the fifth is located in the Caribbean. For purposes of specialization, four sections have been constituted: Fruits, Vegetables, Ornamentals, and the relatively new section devoted to processing.

The *Proceedings* of the Society, of which 61 volumes have so far been published, are issued twice annually and include the majority of the papers presented at the annual meeting. The membership fee covers the cost of these volumes which are sent to both active and associate members. Accepted more or less laconically by the American memberships, the *Proceedings* are received with pride and gratitude in the remote and limited libraries of some of the foreign members.

The evening lecture, entitled "Significance of Growth Regulating Substances in Agricultural Practice," was under the sponsorship of Sigma XI and the American Institute of Biological Sciences. It was delivered by E. J. Kraus who for many years was Chairman, Department of Botany, University of Chicago, and was one of the scientists responsible for new and productive trends in horticultural research.

At the annual banquet, celebrating the fiftieth anniversary of the society, two of the eight surviving charter members, A. T. Erwin and V. H. Davis, were recognized as the honored guests of the society.

The scientific program which was made up of 207 papers included a symposium with the American Society of Plant Physiologists and the physiological section of the Botanical Society of America on the subject of Photoperiodism. The programs of recent years indicate an ever-increasing interest in the effect of hormone treatments on the various plant processes. In addition, reports on the breeding of horticultural crops together with such related aspects as polyploidy, have also been presented. One of the major aspects of present studies seems to be the use of leaf analysis as a diagnostic method of approach to the determination of mineral deficiencies and the problems of plant nutrition. The chemical approach to production problems represents a major trend. There is also evident emphasis on studies concerned with postharvest physiology, including storage of the various horticultural plants.

Anniversary celebrations are for the most part an arbitrary emphasis on the passing of time, but they do serve as the occasion for a backward and forward look. And so from the top of a fifty-year rise, the American Society for Horticultural Science looks back over the territory successfully traversed and forward toward an increasingly fundamental approach to the practical horticultural problem.

FREEMAN S. HOWLETT
American Society of Horticultural Science

Science News

A comprehensive review of science in the United States, covering the year ending June, 1952, has recently been published in London and will go on sale in this country shortly. The booklet was prepared by the British Commonwealth Scientific Office in Washington, successor to the original British Technical Mission that was set up during World War II to facilitate the exchange of technical and scientific information between Britain and the U.S. Such a report is prepared annually by the B.C.S.O., but this is the first one to be published and distributed. Among its findings, the review notes:

That research and development expenditure in the U.S. has increased by 270% during the last decade;

That most of the increase is due to military projects;

That $2,930 million was to have been spent on these activities in the year 1952–53;

That more than half of this sum was supplied by the U.S. Government;

That industrial research and development employs

some 71,000 persons with university degrees or equivalent; and

That of 2,800 industrial laboratories in the U.S., only 7 have staffs of more than 1,000, while more than half employ less than 10 people.

The report goes on to cover a dozen or more phases of U.S. scientific development, including nuclear physics, metallurgy, fuel and power, and mechanical and production engineering. In the section headed "Conservation of Materials," the review notes: "The problem of shortages of raw materials is receiving considerable attention in the U.S.," and states that by 1975 the U.S. demand for minerals will have risen by about 90%. America, formerly one of the world's biggest suppliers of raw materials, is now importing more than she exports.

Expansion of the program for producing "fissionable material" is to cost $4,200 million between 1952 and 1957, the B.S.C.O. booklet observes. It adds, "These figures are large, but should be compared with the vast Defense Department budget which accounts in *one year* for $46,000 million." Of this $4.2 billion earmarked for atomic energy, one billion dollars is to be used to provide a gaseous diffusion plant for the production of uranium, and a further $125 million is to be spent in extending the T.V.A. power plants.

In 1975 the U.S. is expected to consume about double the energy used in 1950. The report notes that today coal provides less than half the energy requirements of this country, and that there is "little pessimism" at present about an immediate shortage of oil, since the discovery of new supplies has more than kept pace with increasing consumption. Work on fuel technology in the U.S. includes investigation of the Fischer-Tropsch process for getting oil from coal, the construction of a coal hydrogenation plant for the production of aromatic hydrocarbons, and experiments in underground gasification.

The authors of the booklet also observed, with some indications of shock, that in some parts of the U.S. water is used at the rate of over 200 gallons a day per person, despite the obvious need for water conservation. Important developments in this field include the perfection of methods of purifying sea and brackish waters to provide water suitable for consumption and for use in industry.

Among other research activities in the U.S., the report lists a new building-construction method of casting concrete slabs for roofs or upper floors of buildings and jacking them into position; the "rapidly increasing" use of antibiotics in the feeding of farm animals; and the "phenomenal rate" of expansion of the chemical industry during 1951.

Tribute is paid to the help received from American scientists and officials all over the country, and in every type of institution. "The courtesy and cooperation encountered," the introduction states, "are however so universal that only the newcomer to the U.S.A. is surprised."

The report is available for 65¢ at the British Information Services office, Rockefeller Plaza, N.Y.C.

Scientists in the News

Floyd S. Daft, Acting Director of the National Institute of Arthritis and Metabolic Diseases, National Institutes of Health since the resignation of Russell M. Wilder last June, has been appointed Director. Dr. Daft, a specialist in nutrition, has been associated with NIH since 1937.

Last year the Duke Endowment provided funds for the establishment of James B. Duke professorships at Duke University. Recently the first group of scholars to receive the special appointments was announced. The following scientists were among those named: **W. C. Davison,** pediatrics; **Fritz London,** chemical physics; **Joseph E. Markee,** anatomy; **Walter M. Nielsen,** physics; **Walter J. Seeley,** electrical engineering; and **Frederick A. Wolf,** botany. The men who received these new chairs have served the university an average of 23 years each.

Maurice C. Fishler, Head of the Biological and Medical Sciences Division of the U.S. Naval Radiological Defense Laboratory, San Francisco, has been ordered to military duty as a 1st lieutenant in the Medical Corps, U.S. Army. Dr. Fishler has served the laboratory since 1948.

Otto Hans Gauer has been appointed Associate Professor of Physiology in the Duke University School of Medicine.

Joel H. Hildebrand, Emeritus Professor of Chemistry and former dean of the College of Arts and Sciences at the University of California, is spending 2 months at the Argonne National Laboratory giving a series of lectures and consulting with the chemistry staff members. Dr. Hildebrand's stay is in accordance with the laboratory's plan to bring outstanding scientists for short visits to stimulate work in various fields.

Elizabeth S. Russell, a geneticist who has been associated with the Roscoe B. Jackson Memorial Laboratory since 1937, has been elected Staff Scientific Director of the laboratory.

The Camille and Henry Dreyfus Foundation of New York City has established a chair in chemistry at Mount Holyoke College for a 5-year period. **Mary Lura Sherrill,** a member of the college faculty since 1921 and Chairman of the Chemistry Department since 1946, has been appointed to the new chair.

The Office of International Relations, National Academy of Sciences—National Research Council, has provided the following information concerning the travel plans of scientific **visitors to the United States:**

Karl Roessel-Majdan, Director, Radio Institution, University of Vienna. Arrived Aug. 21 for 90-day stay on International Educational Exchange Service program. c/o Miss Elizabeth Jorzick, Programs Branch, Leaders Div., Dept. of State.

Allen Sadler, Engineer, Research Laboratory, S.

Smith and Sons, Ltd., Cheltenham, England. Has arrived for a year's study at the Massachusetts Institute of Technology.

J. W. G. Porter, National Institute for Research in Dairying, Agricultural Research Council, England. Arrived end of August for a 4-month stay. c/o Prof. Carl Hoglund, Michigan State College.

V. A. Bailey, Professor of Physics, University of Sydney, Australia. Will serve as a Visiting Professor of Engineering Research at the Ionosphere Research Laboratory, Pennsylvania State College, until June 30, 1954.

Ranan B. Banerji, Honorary Lecturer, University of Calcutta, India. Arrived in October for at least a year's research at the Ionosphere Research Laboratory, Pennsylvania State College.

J. W. Dungey, Research Fellow, University of Sydney, Australia. Will arrive in November for research in solar physics at the Ionosphere Research Laboratory, Pennsylvania State College.

Ashesh P. Mitra, Council of Scientific and Industrial Research, Calcutta. Arrived in September, 1952, for work at the Ionosphere Research Laboratory, Pennsylvania State College, until June 1954.

Marcel Nicolet, Royal Institute of Meteorology, Brussels, Belgium. Arrived Sept. 15 for at least six months' research at the Ionosphere Laboratory, Pennsylvania State College.

Andrew Davidson, Chief Medical Officer, Dept. of Health, St. Andrew's House, Edinburgh, Scotland. Here Nov. 5 to Dec. 12 to attend American Public Health Assoc. meetings. c/o Josiah Macy, Jr. Foundation.

Bjorn Folkow, Associate Professor of Physiology, University of Gothenburg, Sweden. Arrived Sept. 6 for indefinite stay. c/o Josiah Macy, Jr. Foundation.

Jacques Henriet, Surgeon, Hospital and Maternity Center of Pontarlier, France. Arrived Aug. 28 for 120-day Dept. of Health, Education and Welfare program. c/o Miss Elizabeth Jorzick, Programs Branch, Dept. of State.

H. W. Kosterlitz, Senior Lecturer in Physiology, University of Aberdeen, Scotland. Arrived Sept. 7 for stay until February. c/o Dr. O. Krayer, Pharmacology Dept., Harvard Medical School.

C. B. McKerrow, National Institute for Medical Research, England. Arrived Aug. 28 for about a year's work with Dr. Otis of Johns Hopkins University.

J. G. Millichap, Medical Research Council, England. Arrived Oct. 6 for about one year. c/o Prof. Randolph Byers, Dept. of Neurology, Boston Children's Hospital.

Bror Rexed, Secretary, Swedish Medical Research Council. Arrived Sept. 2 for 90-day stay on an International Educational Exchange Service program. c/o Dr. Keith Cannan, Div. of Medical Sciences, National Academy of Sciences, 2101 Constitution Ave., Washington 25, D.C.

Dr. Sloane-Stanley, Medical Research Council, England. Arrived Oct. 9 for a year's travel on an Eli Lilly fellowship c/o Prof. J. Folch-Pi, McLean Hospital, Waverly, Mass.

Frank G. Young, Professor of Biochemistry, University of Cambridge, England. Arrives in early November for indefinite stay. Will attend Conference on Adrenal Cortex. c/o Josiah Macy, Jr. Foundation.

Education

James Hillier will give the 2nd annual **Edsel B. Ford Lecture** at the Edsel B. Ford Institute for Medical Research, The Henry Ford Hospital, Detroit, Dec. 8. His subject will be "Some Results of the Application of Electron Microscopy to Medicine." The lecture will describe two of Dr. Hillier's latest contributions in the field, (1) the ultrastructure of the plasma membrane of human erythrocytes, and (2) the division of bacterial cells as revealed by ultrathin sectioning techniques.

During the Spring quarter of 1954 (March 24 to June 4) the **Institute of Statistics of the University of North Carolina** will sponsor a special program of course work, lectures and seminars on statistics for research engineers, physicists, and chemists. The primary objective of this program is to provide an opportunity for industrial research workers to acquire a working knowledge of modern statistical concepts and techniques. Emphasis will be on the efficient design of experiments and the analysis of data therefrom. Informal seminars on statistical problems submitted by the participating students will be held. Guest lecturers will include W. J. Youden and M. G. Kendall. Regular college credit will be granted for course work satisfactorily completed. For further information write to Institute of Statistics, North Carolina State College, Box 5457, Raleigh.

Grants, Fellowships, and Awards

The American Journal of Surgery, an internationally known, independent monthly publication established in 1891, has been honored as recipient of the first **Honor Award for Distinguished Service in Medical Journalism** to be given by the American Medical Writers' Association. The award, consisting of a plaque, was presented to the Editor of *The American Journal of Surgery*, Thurston Scott Welton of Brooklyn, N. Y., Emeritus Professor of Clinical Obstetrics and Gynecology, State University of New York. The award is presented annually "for accuracy, clarity, conciseness and newness of information in articles, editorials and other material; for excellence of design, printing and illustrations, and for distinguished service to the medical profession," rendered by a United States or Canadian medical periodical.

Shulton, Inc., manufacturers of toiletries and fine-chemicals, announces that a **Shulton Fellowship Fund** has been placed in the Department of Chemistry at the University of Rhode Island, College of Arts and

Sciences, for the purpose of sponsoring a graduate student, during 1953–54, to do research work relative to the production of chemicals by means of vapor phase methods.

The **University of Delaware** has been awarded a contract by the **RCA Victor Division, Radio Corporation of America** under which the university's Department of Psychology will conduct a research program in the field of psychoacoustics. The contract provides for the construction of a special soundproof laboratory to be added to the present facilities of the psychology department. F. Loren Smith, Assistant Professor of Psychology, is chief investigator for the project, and will be assisted by scientists and engineers of the RCA Engineering Products Department and members of the university's staff.

The purpose of the research program is to provide basic information concerning the factors which contribute to understanding speech, and to develop reliable techniques for evaluating the difficulty of speech reception under various conditions. By awarding the contract, RCA Victor becomes a pioneer among industries in giving support for university research in speech intelligibility.

Sigma Delta Epsilon, graduate women's scientific fraternity, has announced a predoctoral fellowship of $1400. *Applications for the year 1954–1955 should be submitted before Feb. 1, 1954,* to the Fellowship Board authorized to make the award of the fifth **Sigma Delta Epsilon Fellowship.**

Women with the equivalent of a master's degree, carrying on research in the mathematical, physical, or biological sciences, who need financial assistance to complete work for the doctorate and who give evidence of high ability and promise, are eligible. During the term of her appointment the appointee must devote the major part of her time to the approved research project, and not engage in other work for remuneration (unless such work shall have received the written approval of the Board before the award of the fellowship).

Application blanks may be secured from Dr. Esther S. Anderson, Geography Department, University of Nebraska, Lincoln 8, Neb. Announcement of the award will be made early in March.

Meetings and Elections

The American Board of Psychiatry and Neurology is holding its annual meeting and examination Dec. 14–15, following the meeting of the Association for Research in Nervous and Mental Disease. The examinations will be held at the New York Psychiatric Institute and the Neurological Institute.

The 4th annual meeting of the Animal Care Panel, sponsored by the University of Chicago and the Argonne National Laboratory, will be held Dec. 2–3 in the Billings Hospital, Chicago. The Panel has just been incorporated and will be fully organized at the business session of this meeting. Robert J. Flynn, Box 299, Lemont, Ill., is secretary-treasurer of the Panel.

The **3rd Annual Wayne University Symposium on Blood** will be held on Jan. 9, 1954, in the College of Medicine auditorium, Detroit. The session is to be opened by Sir Lionel Whitby of Cambridge. Papers by Benjamin Alexander, Shirley Johnson, Koloman Laki, G. J. Millar, Frank C. Monkhouse, Sol Sherry, L. M. Tocantins, and other active investigators are on the program. Inquiries may be addressed to Dr. Robert I. McClaughry, Assistant Dean, Wayne University College of Medicine.

The Springfield Chapter of the AAAS will hold a meeting on Dec. 3 in the auditorium of the Springfield Natural History Museum. Omar T. Pace and Alphonso Palermo, surgeons, and William Kaufman, pathologist, will discuss the following aspects of cancer: (a) etiologic factors; (b) current means of diagnosis and treatment; (c) newer aspects of treatment. A question period will follow. Walter W. Williams, chairman of the chapter, will preside as moderator.

Any person wishing to join the Springfield Chapter should communicate with Philip H. Cinis, 73 Melha Ave., Springfield 4, Mass.

Distinguished physicians and dentists from England, Canada, and many parts of the United States will take part in **symposia at the University of Buffalo** Dec. 11–12. The symposia will be held in connection with dedication exercises for Samuel P. Capen Hall, the new building for the Medical and Dental Schools of the University of Buffalo. The building was recently completed at a cost of $4,500,000. The University of Buffalo is a private institution, and the funds were given by individuals and corporations.

Participants in the symposia will include: Charles H. Best, co-discoverer of insulin, Professor of Physiology and Director of the Banting-Best Institute at the University of Toronto; Robin R. A. Coombs, Assistant Director of Research, Institute of Pathology, University of Cambridge, England, who is well-known for the "Coombs Test" for the detection of Rh sensitization in new-born babies; Stanley E. Dorst, President of the Association of American Medical Colleges and Dean of the University of Cincinnati College of Medicine; and Maynard K. Hine, President of the American Association of Dental Schools and Dean of the University of Indiana School of Dentistry. Samuel P. Capen, after whom the new building is named, will be guest of honor. He is Chancellor Emeritus of the University of Buffalo, and served as Chancellor from 1922 to 1950. Separate symposia have been designed for those interested primarily in research, in education, or in practice.

The Biochemical Institute, The University of Texas, is sponsoring a **Symposium on B-Vitamins** to be held Dec. 3–5. The program follows:

G. M. Brown and E. E. Snell, The University of

Texas, "Microbiological Activity and Biosynthesis of Pantethine and Related Compounds."

M. Calvin, The University of California, "Some Observations on the Chemical and Photochemical Behavior of the Trimethylene Disulfide Ring Which Appears as a Structural Element of Lipoic Acid."

R. E. Eakin, The University of Texas, "*In Vitro* Studies on B_{12} Binding Proteins."

K. Folkers, Merck and Co., "Synthesis of Pantetheine and S-Acetylpantetheine."

D. E. Green, The University of Wisconsin, "Acyl Coenzyme A and Fatty Acid Oxidation."

S. M. Hauge, Purdue University, "Vitamin B_{12}."

B. L. Horecker, The National Institutes of Health, "The Role of Thiamin Pyrophosphate in the Transformation of Sugars."

B. L. Hutchings, Lederle Laboratories, "Some Chemical and Biological Properties of Coprogen."

E. M. Lansford, J. M. Weaver, and W. Shive, The University of Texas, "Studies on Thymidine Function and Distribution."

H. A. Lardy, The University of Wisconsin, "The Relation Between Biotin and Carbon Dioxide Fixing Reactions in Animals and Bacteria."

H. R. Mahler, The University of Wisconsin, "Metallo-flavoproteins."

W. Prusoff and A. D. Welch, Yale University, "The Intrinsic Factor."

L. J. Reed and B. G. DeBusk, The University of Texas, "Enzymes and Co-factors Functioning in Oxidative Decarboxylation."

D. Rogers, T. E. King, and V. H. Cheldelin, Oregon State College, "Glucosylglycine and Related Factors Produced by Heating Growth Media."

E. E. Snell, D. E. Metzler, and M. Ikawa, The University of Texas, "Reactions of Pyridoxal with Amino Acids."

J. B. Walker, The University of Texas, "Metabolism of Arginosuccinic and Canavanosuccinic Acid."

R. J. Williams, The University of Texas, "Biochemistry Moves Toward Human Understanding."

L. D. Wright, Sharp and Dohme, "*AN* Factor: Description, Isolation, and Characterization."

The program for **The William Pyle Philips Lecture Series** on nuclear science at Haverford College is as follows:

Oct. 14. Glenn T. Seaborg, Professor of Chemistry, University of California, Berkeley; 1951 recipient of the Nobel Prize in Chemistry. "The Transuranium Elements—Recent Developments."

Nov. 18. Enrico Fermi, Charles H. Swift Distinguished Service Professor of Physics, University of Chicago; 1938 recipient of the Nobel Prize in Physics. "Recent Results in High Energy Physics."

Dec. 9. Raymond E. Zirkle, Professor of Radiobiology, Institute of Radiobiology and Biophysics, University of Chicago. "Effects of Radiations on Living Cells."

Jan. 6. Harrison Brown, Professor of Geochemistry, California Institute of Technology, Pasadena. "The Age of the Earth."

Feb. 24. Walter H. Zinn, Director, Argonne National Laboratory, Chicago. "Nuclear Power Development."

March 24. Martin Schwarzschild, Eugene Higgins Professor Astronomy, Princeton University. "Stellar Evolution."

April 14. The Hon. W. Sterling Cole, Chairman, The Joint Committe on Atomic Energy of the House and Senate. "The Role of Government in Nuclear Development."

Miscellaneous

The **Chemical-Biological Coordination Center** of the National Research Council is searching for samples of additional organic compounds for their screening program. One of the objectives of the Center is to obtain a broad general screening of as many compounds as possible. To date approximately 6300 compounds have been tested in this manner. Samples are accepted from industrial, governmental, university, and other research laboratories. Forms are provided for the name, structure, and physical properties of the compounds to be submitted. On the basis of this information, some 35 screening agencies cooperating with the Center select the chemicals they wish to test. After these selections have been made, the total amounts of the samples needed are requested from the submitters of the compounds and redistributed to the screeners.

These screening agencies are all governmental, university, or other non-profit laboratories and conduct about 25 different types of tests against a variety of microorganisms, plants, and animals. Copies of the results from this screening are returned promptly to the submitter. Also, after 3 months these data are incorporated into the Center's punched card files, making them available for the use of scientists requesting information and for correlation studies. When a compound is found to be of interest after the preliminary tests, the Center assists in establishing contact between the submitter and the screening agency. In cases where practical uses are found for compounds, the Center itself does not file patent applications. Inquiries may be addressed to Miss Estaleta Dale, Research Assistant, Chemical-Biological Coordination Center, National Research Council, 2101 Constitution Avenue, Washington 25, D.C.

A grant by the Louis W. & Maud Hill Foundation of St. Paul has made possible the formation of the **Minnesota Center for Philosophy of Science,** which is administratively a department of the University of Minnesota in Minneapolis. The present research staff includes: Herbert Feigl, Director; Wilfrid Sellars (Chairman of the Philosophy Department); Paul Meehl (Chairman of the Psychology Department); and Michael Scriven (M.A., Melbourne, Instructor in Philosophy).

Technical Papers

Handedness in the Rhesus Monkey

J. M. Warren[1]

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The purpose of the observations reported in this paper was to determine the degree of hand preference and the distribution of the right- and left-handedness in a sample of 84 adolescent and mature rhesus monkeys (*Macaca mulatta*).

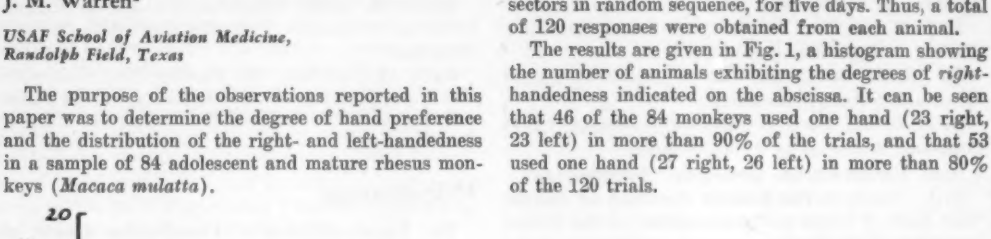

FIG. 1.

All the subjects were tested in the Wisconsin General Test Apparatus ([*1*], Fig. 1), which consists of a restraining cage, table, and superstructure supporting an opaque screen in front of the subject, and a one-way vision screen in front of the experimenter. On the table is a movable Klüver formboard, 30 by 8 in., with three food wells spaced 6 in. apart in the center of the board, the two extreme food wells being 12 in. from the edges of the formboard. The board was divided into six sections, right-, left-, and centerfront, and rear, by a line bisecting the formboard horizontally, and by two lines drawn vertically to the right and left of the extreme food wells.

Each test trial began with the forward screen lowered in front of the subject. The experimenter placed a single piece of food (peanut, apple, grape, or raisin) in one of the six sectors, lowered the one-way screen, raised the opaque screen, pushed the tray forward, and observed which hand the monkey used to pick up the food. Twenty-four such presentations were made daily, with four pieces being given in each of the six sectors in random sequence, for five days. Thus, a total of 120 responses were obtained from each animal.

The results are given in Fig. 1, a histogram showing the number of animals exhibiting the degrees of *right*-handedness indicated on the abscissa. It can be seen that 46 of the 84 monkeys used one hand (23 right, 23 left) in more than 90% of the trials, and that 53 used one hand (27 right, 26 left) in more than 80% of the 120 trials.

The results of the present experiment, in spite of the relatively small number of trials obtained from individual subjects, may be compared with those reported by Finch (*2*), who tested 31 chimpanzees for 800 trials in four different situations. Table 1 compares Finch's chimpanzee results with the rhesus monkey results of

TABLE 1

A COMPARISON OF HAND PREFERENCE IN MONKEYS AND CHIMPANZEES

	Per cent of monkeys	Per cent of chimpanzees (*2*)
Preferred hand used		
> 90% of trials	54.8	46.2
Right	27.4	23.1
Left	27.4	23.1
Preferred hand used		
> 80% of trials	63.1	64.1
Right	32.1	28.2
Left	31.0	35.9

[1] Present address: Psychology Department, University of Oregon, Eugene.

the present investigation. This table shows that the strength of hand preference is approximately equal, and that the proportion of right- and left-handedness is similar in the two species. Finch's more elaborate technique probably provided a more valid measure of hand preference than that of the present study, but there appears to be little evidence for assuming any significant difference in the degree of lateral dominance found in the rhesus monkey and the chimpanzee in so far as the experiments provided accurate measures of handedness in the two species.

Kounin (*3*) has criticized observations of the hand used for picking up food as a test of handedness, since "unnoticeable posturing and situational expediencies" render this task too unreliable for demonstrating the existence of handedness in monkeys. The results of the present investigation, however, suggest that Kounin's conclusion, based on very small samples, may perhaps have been prematurely pessimistic.

References

1. HARLOW, H. F. *Psychol. Rev.*, **56**, 51 (1949).
2. FINCH, G. *Science*, **94**, 117 (1941).
3. KOUNIN, J. S. *J. Genet. Psychol.*, **52**, 375 (1938).

Manuscript received August 14, 1953.

Regeneration of Resected and Crossed Sciatic Nerves in Parabiotic Rats

Howard A. Matzke[1] and Benjamin B. Kamrin[2]

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It is possible successfully to unite animals surgically in parabiosis. In the mammal such parabiosis will occur only if the animals are littermates. Even in the latter instance, it is found that a successful union is obtained in only 25% of the cases. Successful parabiosis is characterized by complete healing of the tissues, common circulation of the blood, and elimination of the skin suture line. By virtue of the compatibility of the tissue of these genetically similar, united animals, the suggestion was raised by Morpurgo (*1*) that resected nerves from one parabiont may regenerate into the distal sheath of the other parabiont. He claimed that there was functional connection of the newly formed nerve fibers of one rat with the muscles and skin of the other. However, his experiments did not include a study of the extent of regeneration as compared to controls, nor did he elaborate on the rate of recovery and cross-sectional fiber counts.

This series of experiments was intended to assess the phenomenon of cross nerve regeneration in a parabiotic host, to study the rate of regeneration and number of regenerating fibers, and to compare these data with that from nerve regeneration in single control animals.

[1] Present address: Department of Anatomy, University of Kansas, Lawrence, Kansas.

[2] The authors wish to express their appreciation to Clyde W. Monroe for his technical assistance.

TABLE 1

FIBER COUNTS OF THE SECTIONED ALBINO RAT SCIATIC NERVE

	Period of regeneration, days		Proximal nerve count		Distal nerve count	
	Av	Range	Av	Range	Av	Range
Normal	—	—	6497	6103–6864	6497	6103–6864
Control	81	50–113	7937	7817–8056	4406	3960–5272
Parabionts	56	29–91	7176	6802–8582	6317	4532–8102

The right sciatic nerves of 4 single albino rats (Wistar) were resected and reunited with tantalum wire (6-0 gage). Animals were tested daily for signs of functional recovery. At varying periods of time, these animals were sacrificed and the proximal and distal segments of the regenerated nerve were prepared for nerve fiber counts. Four littermate pairs of rats of the same strain were placed in lateral parabiosis (*2*). At the same time the sciatic nerves of the adjacent limbs were severed. The proximal nerve stump of the left leg of the right animal was sutured with 6-0 tantalum wire to the distal sciatic nerve stump of the right leg of the left animal. The united nerve was covered with a .0025-gage tantalum foil sheath. The remaining proximal and distal resected trunks were similarly treated. These animals were observed for functional recovery and sacrificed at varying times. Fiber counts were made of the distal and proximal segments of the regenerating nerves.

The first sign of sensory recovery, as elicited by pinching the toes of the involved extremity, was noted in 35–40 days in the control animals and 28–42 days in the parabionts. Motor recovery followed this period by 4–7 days.

At the time the animals were to be sacrificed, electrical stimulation of the proximal segment of the regenerated sciatic nerve of one parabiotic animal showed the same intensity of response in the opposite member as was observed in control animals of the same postoperative period.

The number of fibers in the distal segment of the crossed sciatic nerve in parabiotic animals was at no time less than in the distal segments of the controls with the same regeneration time (Table 1).

In summary the following points may be stated: (*a*) the proximal segment of a severed sciatic nerve can be made to regenerate into the distal sheath of the sciatic nerve of a littermate in parabiosis; (*b*) time of functional recovery, response to pain, and response to electrical stimulation is significantly similar to that found in single uncrossed control animals; and (*c*) the number of fibers in the distal segment of the regenerating nerve in parabionts consistently shows a higher count than in the controls.

The phenomenon of crossed nerve regeneration in parabiosis adds further support to the belief that the

control of regeneration is central rather than peripheral. It would seem unlikely that a nerve would regenerate as rapidly and to the same degree into foreign tissue as into its own if it were dependent upon a chemotactic influence exerted by the peripheral end organs.

References

1. Morpurgo, B. *Klin. Wochschr.*, **2**, 129 (1923).
2. Bunster, E., and Meyer, R. K. *Anat. Record*, **57**, 339 (1933).

Manuscript received August 10, 1953.

Failure of Atropine to Produce Pupillary Dilatation

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University of Tennessee Medical Units, Memphis

In a recent series of experiments the authors (*1*) had occasion to administer atropine sulfate to anesthetized dogs and observed that under the conditions of the experiments, atropine did not produce the usual pupillary dilatation. This finding seemed so unusual that it was deemed worthy of recording in the literature.

The experiments in question involved the measurement of intraocular pressure by use of the Hamilton optical manometer (*2*). This was accomplished by anesthetizing the dogs with 30 mg of pentobarbital sodium/kg of body weight intravenously and passing a sharp, short 24-gage needle through the cornea near the limbus. The needle was attached to a length of lead tubing which was connected in turn to the manometer for photographic recording. Within a few minutes after passing the needle through the cornea, the pupil became tightly constricted in all the dogs used and failed to respond to rather large doses of atropine.

The presence of miosis in these experiments may be attributed to a reflex originating in the cornea, since it is well known that injury to the eye will produce pupillary constriction. In general, sensory stimuli to the eye and iritis will produce constriction of the pupil (*3*). Additional evidence in this direction is offered by the fact that pupillary constriction occurred only in the experimental eye and not in the opposite eye. Thus, after the administration of atropine, the control pupil was fully dilated while the experimental pupil was tightly constricted. Therefore, it is postulated that passing a needle through the corneal membranes sets off impulses that activate the constrictor fibers of the pupil either via the central reflex route or by an axon reflex. That this constriction was not due to other procedures used in these experiments was shown by the fact that miosis refractory to atropine was obtained in animals where cannulation was the only procedure.

[1] Fellow, American Foundation for Pharmaceutical Education.

[2] This paper is a portion of a dissertation submitted in partial fulfillment of the requirements for the degree of Master of Science, University of Tennessee.

The effect of electrical stimulation of the cornea was tested in the pentobarbitalized, atropinized dog by applying a mild electrical stimulation (Harvard inductorium, 3 v input, coil setting 9) to the cornea for 2 sec. No change in the pupil size developed. However, stronger, more prolonged stimulation (duration 30 sec, coil setting 2), which caused a small burn of the cornea, did cause miosis. This miosis, however, did not appear until 15–20 min after discontinuing the electrical stimulation. This type of injury, as well as needle puncture, cause a delayed miosis in the atropinized eye.

In an effort to overcome this miosis various drugs were tried. A 1% atropine sulfate solution was instilled in the eye, 2 drops every 10 min, for a period of 1 hr without producing any appreciable effect on the pupillary constriction. Atropine sulfate was then administered intravenously beginning with a dose of 1 mg and continuing to a total dose of 5 mg/kg of body weight with the same negative results. As further check 0.25 ml of a 1% solution of atropine was injected directly into the anterior chamber. Since none of these procedures produced dilatation, it is obvious that atropine was of no value in overcoming this miosis.

Other drugs that were tested included tetraethylammonium chloride, a ganglionic blocking agent, in a dose of 10 mg/kg body weight; Mytolon, a muscle relaxant, in gradually increasing amounts until complete respiratory paralysis occurred; and Regitine, an adrenergic blocking agent, in a dose of 5 mg/kg. All these drugs, given intravenously, were found to be ineffective in the doses used in preventing the above described miosis.

Since ganglionic blockade was without effect, it seemed likely that the miosis was due to an axon reflex. The only group of autonomic drugs that was found to be effective was the sympathomimetics. By intravenous administration, epinephrine hydrochloride, 10 μg, or ephedrine sulfate, 3 mg/kg of body weight, gave a prompt mydriatic action.

On the assumption that the constriction was due to a reflex originating in the cornea, a local anesthetic, tetracaine hydrochloride, was instilled in a concentration of 0.5%, using 2 drops every 30 min, and beginning 30 min prior to cannulation of the cornea. Thirty to 45 min after this procedure atropine would produce near maximal pupillary dilatation. This dilatation, however, was limited in duration. In spite of continued use of tetracaine, within 1.5–2 hr after the first appearance of mydriasis, the pupil began to constrict again, and a few minutes later a state of maximal constriction was obtained. When this point was reached, further doses of atropine or tetracaine were without avail.

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The Modification of the Teratogenic Action of Cortisone by Parity[1]

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During an investigation of the genetics of strain differences in the response of mice to the teratogenic effects of cortisone (*1, 2*), it was observed that the frequency of cleft palate in the offspring of treated mice varied with the parity of the female. The cross which permitted the most precise statistical analysis of this phenomenon was the backcross of F_1 females from reciprocal crosses between strains C57BL/6Jax and A/Jax (*3*) to strain A/Jax males. In this cross the F_1 females had comparatively large litters, many litters, and a mean frequency of the anomaly intermediate between those of the parent strains (*2*).

TABLE 2

TEST OF SIGNIFICANCE BETWEEN FIRST AND ALL OTHER LITTERS FROM TREATMENTS BEGUN ON GESTATION DAYS 10 TO 12

	Parity		Total
	1	2–9	
Normal	85	361	446
Cleft palate	39	73	112
Total	124	434	558

$\chi^2 = 11.8$, $P < 0.001$

TABLE 1

NUMBER AND PER CENT AFFECTED OFFSPRING ACCORDING TO PARITY RESULTING FROM TREATMENTS BEGUN ON GESTATION DAYS 10 TO 12

	Parity							Total
	1	2	3	4	5	6	7–9	
Total number of offspring	124	123	94	78	63	39	37	558
Number with cleft palate	39	26	19	13	8	5	2	112
Percentage with cleft palate	31.5	21.1	20.2	16.7	12.7	12.8	5.4	20.1

Animals were fed Purina Fox Chow and water ad libitum. Pregnant females were treated intramuscularly in the flank with 2.5 mg of cortisone acetate (11-dehydro-17-hydroxycorticosterone-21-acetate)[2] on 4 successive days of the gestation period. None of 87 offspring of untreated F_1 females had a cleft palate.

Pregnant females were treated beginning on the 6th to 17th days of gestation. The highest incidences of the defect were caused by treatments which began on gestation days 10, 11, and 12. The results for these days were pooled, and a statistical test was made on this material to determine whether there was any effect of parity on the frequency of cleft palate. The results show that with each successive litter the frequency of the defect decreased (Table 1); however, only the frequency of the defect in 1st litters (32%) is significantly greater, statistically, than the frequency in all other litters (16%, Table 2), or any other litter.

The possibility was considered that those females most susceptible to the teratogenic effects of cortisone also became sterile or died sooner than the less susceptible females, and that their progressive elimination from the population might have caused the decreasing incidence of the defect in successive litters. Thirty-three females were involved in this experiment. The modal life span of these animals (i.e., age at death or discarding) was 13 months. Of these 33 females, 19 lived less than 13 months (total of 151 months, mean = 7.95 months) and had 84 conceptions (mean = 4.42 conceptions). The remaining 14 lived a total of 186 months (mean = 13.29 months) and had 104 conceptions (mean = 7.43 conceptions). The ratio of number of conceptions to life span in months, however, is the same, 0.56, for females that lived less than 13 months and for females that lived 13 or more months ($t = 0.08$, d.f. = 31, $P > 0.9$). It is apparent, therefore, that these 2 groups of females were equally fertile.

Ten of the 33 females conceived less than 5 times (total 25, mean = 2.50 conceptions); these lived a total of 70 months (mean = 7.0 months). The other 23 females conceived a total of 163 times (mean = 7.09 conceptions) and lived a total of 267 months (mean = 11.61 months). The ratio of number of conceptions to life span in months for the 1st group is 0.36, for the 2nd group, 0.61. The conception rate, therefore, is

TABLE 3

FRACTION OF AFFECTED OFFSPRING IN FIRST FOUR LITTERS OF FEMALES WITH LESS THAN FIVE AND FIVE OR MORE CONCEPTIONS, RESULTING FROM TREATMENTS BEGUN ON GESTATION DAYS 10 TO 12

Times females conceived	Parity			
	1	2	3	4
Less than 5	11/29	5/38	3/11	0/ 6
5 or more	28/95	21/85	16/83	13/72
χ^2	0.40	1.47	0.05	—
P	0.53	0.22	0.82	0.32*

* Probability derived by use of Fisher's (*4*) exact treatment of the 2 × 2 table.

[1] The investigation of which this report is a part was supported by the Kate E. Taylor Fund of the Banting Research Institute, Toronto, Canada, and is being supported by the National Cancer Institute, United States Public Health Service.

[2] Cortisone generously supplied by J. H. Laurie, Merck and Co., Ltd., Montreal.

almost twice as great for the group with 5 or more conceptions than for the group with less than 5 conceptions. The difference, however, is not statistically significant ($t = 1.12$, d.f. $= 31$, $P = 0.2$–0.3).

It was thought advisable, nevertheless, to test the frequencies of the defect in the offspring of the latter 2 groups of females against each other. The results show (Table 3) that each of the first 4 litters of the "sterile" females is not statistically different from its counterpart from the "nonsterile" females. The possibility is excluded, therefore, that the decreasing frequency of the defect in successive litters was due to the sterilization of the more susceptible females, and the conclusion can be drawn, from Table 1, that primigravid females are significantly more susceptible to the teratogenic effects of cortisone than multigravid females.

It is interesting to note (Table 3), however, that a good deal of the parity effect is due to the "sterile" group, and that when the results for this group are not considered, the difference in incidence of the defect between the 1st and 2nd litters of the "nonsterile" group is not significant ($\chi^2 = 0.29$, $P = 0.59$).

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Effects of Oral Administration of Spanish Moss, *Tillandsia usneoides* L.

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Spanish moss, *Tillandsia usneoides* L., is described by Small (*1*) as a picturesque and characteristic feature of the southern coastal states. The dried processed inner fiber of the strand of moss has long been utilized in the upholstery industry.

In conjunction with our studies on the estrogenic substance in Spanish moss (*2*), a feeding experiment was devised to show the effects of oral administration of the ground moss to young and adult albino rats.

Twenty fertile adult albino rats of approximately the same age and weight, divided equally as to sex, were placed in two groups each containing 5 males and 5 females. The males and females of each group were separated for 30 days, during which time group I was fed a commercial ration of dog cubes, and group II the same ration powdered and mixed with an equal part by weight of ground Spanish moss.

After feeding this diet 30 days no significant differences in weight were observed.

The rats were then paired with those of opposite sex of their same group and the diets continued. On the 23rd day after the mating, a litter was born to 1 female in each group; 12 young in the litter of group I and 5 in the litter of group II. There was no significant difference in weight at birth. When 18 days old, the young of group I averaged 19.5 g, and those of group II 6.5 g. All 5 young of group II died before they were 20 days old, and only this one litter was born to this group. The animals in group I reproduced normally.

Estrogen administration begun before 4–6 weeks of age inhibits growth and development, but if begun after full growth is attained it does not cause a loss of weight in rats (*3*). The administration of estrogens to lactating mothers inhibits growth of young (*4*). Zondek (*5*) showed a direct relationship between growth inhibition and quantity of hormone administered. The skeletal development as well as organ size is affected. The action is explained by an inhibitory mechanism of the hormone on the anterior pituitary.

Hormonal castration of cockerels by stilbestrol implants is frequently utilized to improve meat quality and stimulate growth. Estrogens apparently have no activity on quantity or quality of meat produced from swine (*6*). A recent publication from Purdue University (*7*) shows that 60 mg-stilbestrol implants in yearling steers will increase daily weight gain by 10%; and 120 mg-implants by 18%. However, 180 mg-implants of testosterone will depress daily weight gain by 2.6%. It is significant that less food is required for a gain of 100 lbs of body weight by animals which received stilbestrol; 4% less food concentrate being required by those receiving 60 mg-implants; and 10% less food by those receiving 120 mg-implants, while the testosterone-treated steers required more food.

In view of the recent trend to improve meat quality by administration of estrogens, it may be possible to utilize the waste material from the processing of fibers of Spanish moss for the upholstery industry, as a fodder supplement for beef cattle. The high fiber content of this waste material would make it unsuitable for feeding swine, but cattle, sheep, and goats could digest the fibers and utilize in addition the vitamin, mineral, and carbohydrate constituents. Webber, *et al.* (*8*) showed the presence of an antibacterial substance in moss. Halligan gives the analysis of green moss (*9*) as:

Protein	3.68%	Iron and aluminum oxide	0.28%
Carbohydrate	15.9%	Phosphate	0.032%
Fiber	8.24%	Calcium oxide	0.058%
Water	69.5%	Sodium oxide	0.58%
Ash	1.57%	Potassium oxide	0.31%

The Florida Agricultural Experiment Station showed that Spanish moss contains more food value than oat straw (*10*) and that moss contains 1.5 mg% of β-carotene, the precursor of vitamin A (*11*). Since the estrogen of Spanish moss is effective by oral administration, it may be possible to utilize the waste from the processing of fibers for the upholstery in-

dustry as a fodder supplement for beef cattle, thereby improving meat quality and increasing quantity in less time with less food.

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2,4-D Affects Phosphorus Metabolism

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A preliminary experiment in which *Commelina* sp. and *Xanthosoma* sp. were analyzed 24 hr, and 1 wk after being treated with 2,4-D (2,4-dichlorophenoxyacetic acid) showed that the percentage of water-soluble phosphorus in treated plants was consistently higher than in untreated plants. The following experiment was carried out to obtain additional information on the effect of 2,4-D on phosphorus metabolism.

A prepared field was divided into 12 plots each 52×24 ft and planted to a variety of white beans, Blanca Bonita (P.R. 1632). The experimental design consisted of 3 treatments each replicated 4 times in randomized blocks.

When the plants were about 15 in. high and had started to set fruit 1 plot in each of the 4 replications was sprayed with 0.1% aqueous solution of sodium 2,4-D. The plants in another plot of each replication were uprooted at the same time and left lying on the ground to die gradually. The third plot in each replication was left as a control. Two rows of unsprayed or undisturbed plants were left as borders around each plot. The treatments were started at 6 A.M., and samples of 100 plants were taken from each replication of all treatments at 4, 10, 24, and 48 hr and 1 wk after treatment.

The leaves, stems, and roots were separated, fresh and dry weights obtained, and a composite sample of 300 g of dry powdered tissue from each replication was analyzed for inorganic phosphorus. Aliquots of a hot water extract of the dry tissues were clarified with 0.5 g charcoal and used for inorganic phosphorus determination as described by Truog and Meyer (*1*).

[1] Administered by the Office of Experiment Stations, Agricultural Research Administration, USDA.

Four hours after treatment the sprayed plants showed epinasty and other 2,4-D effects. Ten hours after treatment many of the leaves had curled, and the plants were becoming recumbent. The next morning the plants were somewhat chlorotic and the distortion had increased. The following day many of the leaves had developed necrotic spots. One week after treatment the leaves on most sprayed plants had withered and those that adhered were very chlorotic and sickly in appearance.

The uprooted plants remained fresh for the first day but after that they deteriorated so rapidly that by the end of the week it was not possible to obtain leaf samples.

Figure 1 shows the fluctuations of inorganic phosphorus in the leaves, stems, and roots, respectively, of treated, check, and uprooted plants.

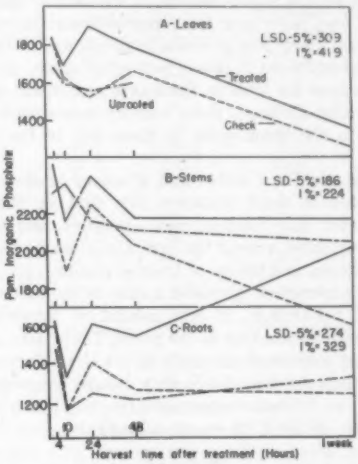

FIG. 1. Levels of inorganic phosphorus (ppm of dry matter) in bean plants analyzed at various intervals after treatment with 0.1% solution of sodium 2,4-D.

The data obtained at each sampling period, expressed as parts of inorganic phosphorus per million parts of dry material, was analyzed statistically by the analysis of variance and the least significant differences between treatments determined.

Four hours after treatment there was no appreciable difference in the amount of inorganic phosphorus in the leaves and roots of treated and check plants, but the stems of treated plants had a significantly higher amount than the checks. The uprooted plants had somewhat less inorganic P than the treated plants in all 3 organs. Ten hours after treatment inorganic P had dropped in all organs of all treatments except in the stems of uprooted plants, where it was somewhat higher; but in roots, stems, and leaves of treated plants it was higher and significantly more so in the roots and stems than in the corresponding organs of check plants. The samples taken 24 hr after treatment showed a sharp rise in the level of inorganic P in roots,

stems, and leaves of treated plants; the level in the roots and leaves was significantly higher than in the checks. There was also a rise in the inorganic phosphorus content of stems and roots of check plants, but it was less than in treated plants. The leaves of check plants showed no increase as did the leaves of treated plants in this phosphorus fraction, indicating that the most pronounced effect of 2,4-D on phosphorus metabolism occurred in the leaves at this time.

Forty-eight hours after treatment the level of inorganic P in leaves, stems, and particularly roots of treated plants was significantly higher than in check plants. In the roots, stems, and leaves of uprooted plants it was about the same as in the check plants. One week after treatment inorganic P in the roots of treated plants had increased significantly and this coincided with a sharp decline in the leaves, indicating that it may have been translocated from the leaves to the roots. There was practically no change in the inorganic phosphorus fraction in treated stems. Although by this time the level in the leaves and stems of check plants also declined, there was no corresponding increase in the check roots as there was in the treated roots.

Inorganic P in leaves and stems of treated plants fluctuated in most instances like that in the check plants, but this fraction was consistent, and at most sampling dates, except the first, significantly higher in roots, stems, and leaves of treated plants.

This experiment provides a clue to the mode of action of 2,4-D, e.g., it may inhibit or interrupt the phosphate metabolism in the plant. These data and the fact that very small amounts of 2,4-D produce drastic effects suggest that 2,4-D may inhibit or poison the enzyme or system responsible for the hydrolysis or synthesis of the high energy phosphates.

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Colorimetric Method for Determination of Aureomycin, Carbomycin, Erythromycin, and Terramycin in Aqueous Solution

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We have observed that the acid hydrolyzates of Aureomycin (*1*), carbomycin (*2*), erythromycin (*3*), and Terramycin (*4*) react with the arsenomolybdate reagent to produce blue colored complexes. The optical density of the color formed has been found to be a function of the quantity of antibiotic present. Satisfactory results have been obtained with the following procedure.

Aliquots containing from 10 to 40 μg of antibiotic are added to colorimeter tubes and the solution evaporated to dryness using an air jet. Two milliliters of 6*N* H_2SO_4 and 1 ml of arsenomolybdate reagent (Nelson's [*5*] reagent diluted with 2 parts of distilled water) are added. The tubes are plugged with loose fitting corks and placed in a boiling water bath. After a 15-min heating period the tubes are cooled to room temperature and the contents diluted with 5 ml of distilled water. Color intensity is determined using a photoelectric colorimeter equipped with 660 mμ filter. A series of tubes containing known quantities of the antibiotic are prepared and treated simultaneously with the tubes containing unknown quantities of the antibiotic. The values obtained with this series of known solution are used to calculate the constants of Beers' law and to standardize the determinations.

The sensitivity of the method varies somewhat with the particular antibiotic under consideration. The practical working range for Terramycin and Aureomycin is from 2 to 40 μg/tube; for erythromycin it is 5–80 μg/tube; and for carbomycin it is 10–160 μg/tube. Smaller quantities may be determined if only 1 ml of distilled water is added after the heating period, and micro cells are used to determine the optical densities. Apparently the hydrolysis with 6 *N* acid is necessary to obtain maximum sensitivity of the method, and use of more dilute acid resulted in reduced sensitivity. Only Terramycin will reduce the arsenomolybdate reagent without a preliminary hydrolysis, and in this instance the working range has been found to be from 20 to 160 μg/tube. Some of the data collected in analyzing aqueous solutions containing known quantities of Terramycin are summarized in Table 1.

TABLE 1

Analysis of Solutions for Terramycin Content

Solution	Terramycin added* μg/ml	Terramycin found† μg/ml
Distilled water	0	0
	10	9.7; 9.9; 10.2
	30	29.8; 30.7; 30.7
	100	98.6; 99.7; 101.5
2% Glucose	0	0
	10	9.5; 9.7; 10.0
	30	27.7; 30.6; 30.6
2% Starch	0	0
	10	9.1; 9.7; 9.7
	30	28.8; 29.0; 29.6

* Terramycin hydrochloride was used in these studies. All analyses are presented in terms of the free base.

† Antibiotic extracted from aqueous solution with methyl isobutyl ketone.

This method cannot be applied directly to solutions containing carbohydrates and other substances which react when heated with the arsenomolybdate reagent. These four antibiotics may be separated from carbohydrates by extraction from aqueous solution (pH 7.2) into chloroform, amylacetate, *n*-butanol and methylisobutyl ketone. All the antibiotic has been recovered in the solvent phase when equal volumes of the solvent and aqueous solution have been used.

The arsenomolybdate reaction employed in this study measures the presence of reducing substances present in the samples after acid treatment. Other reagents for determining reducing substances may be substituted for the arsenomolybdate reagent, including Fehling's reagent and the Folin-Malmros reagent. The arsenomolybdate reagent was preferred as smaller quantities of the antibiotics could be determined than when these other reagents were used.

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Effect of Strenuous Physical Activity on Blood Vitamin A and Carotene in Young Men

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In a recent study of the effects of certain proteins in the diet on the utilization of carotene by growing albino rats (*1*), one of our metameters was the vitamin A content of the blood, micrograms vitamin A/100 ml serum. For groups of 11 rats the average values of this metameter, determined at 3-day intervals, changed in definite consistent patterns during the 38-day vitamin A depletion period and the subsequent 6-wk carotene repletion period. Unexpectedly, for each of the individual 44 experimental animals, puzzling irregular large fluctuations of the blood vitamin A values were observed throughout the experiment. The closely controlled conditions of the experiment and the magnitude and irregularity of the fluctuations suggested that a factor (or set of factors), readily available, immediately effective, and more potent than dietary protein in affecting the blood vitamin A level, existed within the body of the rat. A factor possibly capable of meeting these specifications is physical activity.

Since an estimate of the effect of physical activity on blood vitamin A values is more easily made with human beings as the subjects than with rats, a preliminary test of the effect of physical activity was made with the cooperation of Coach A. C. Moreau and twelve members[2] of the Louisiana State University track team. Vitamin A and carotene analyses were made by the method of Bessey *et al.* (*2*) on samples of finger blood collected from each man about 3 min before the start of a 40–50 min period of strenuous physical activity which consisted of a 15-min "warm-up" period, followed by running five or six 220-yd dashes at full speed (26–29 sec/dash, at intervals of 5 min). About 6 min after the completion of the last dash, the 2nd sample of blood was collected. The exercises were performed between 3 and 4 P.M. Samples of blood were collected also at these times from 2 controls who remained seated while the 12 men were running.

In Table 1 are given the observed levels of serum vitamin A before and after the exercise, as well as the per cent change following exercise; similarly, in Table 2 are given the carotene values.

TABLE 1

Subject no.	μg vitamin A/100 ml serum			Per cent change
	Before exercise	After exercise	Change	
1	25.2	43.7	18.5	73
2	30.4	62.7	32.3	106
3	44.9	61.6	16.7	37
4	51.0	74.8	23.8	47
5	46.4	36.0	−10.4	−22
6	48.4	68.6	20.2	42
7	39.3	69.1	29.8	76
8	55.9	67.0	11.1	20
9	34.3	44.0	9.7	28
10	31.2	49.0	17.8	57
11	40.7	56.8	16.1	40
12	29.4	48.9	19.5	66
Controls				
13	95.8	92.0	− 3.8	− 4
14	61.7	73.3	11.6	19

The average blood vitamin A level of the group increased 43% during the work-out with individual changes varying from an increase of 106% to a decrease of 22%; the average carotene level decreased 10%, with individual changes varying from +17 to −50%.

According to the coach, subject 2, whose vitamin A

TABLE 2

Subject no.	μg carotene/100 ml serum			Per cent change
	Before exercise	After exercise	Change	
1	63.1	60.3	− 2.8	− 4
2	79.9	93.4	13.5	17
3	93.4	85.6	− 7.8	− 8
4	101.4	98.6	− 2.8	− 3
5	113.5	56.8	−56.7	−50
6	131.4	103.1	−28.3	−22
7	104.7	113.9	9.2	9
8	154.4	141.0	−13.4	− 9
9	143.9	97.4	−46.5	−32
10	117.7	127.4	9.7	8
11	126.9	123.0	− 3.9	− 3
12	63.1	57.5	− 5.6	− 9
Controls				
13	143.4	133.7	− 9.7	− 7
14	94.6	109.3	14.7	16

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[2] We thank J. R. Burton, R. O. Dean, A. C. James, C. L. Johnson, J. L. Kepler, H. T. McBride, J. O. Phillips, J. H. Shirley, C. C. Smith, H. F. Sweeney, E. Z. Tucker, and J. T. Venable for performing the exercises and donating the blood.

level increased 106%, was in poor condition, while subject 5, the only runner to show a decrease in blood vitamin A, was in excellent condition.

Further studies using athletic subjects under controlled conditions of diet and exercise are being conducted.

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Chromosome Numbers of Some American Rodents

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While visiting several universities in this country, as an official representative of the Japanese Government, I was able to collect some mammalian material for chromosome research and I wish to report the chromosome numbers so far established for 16 species of American rodents with some comments. The results are summarized in Table 1.

The chromosomes of the deer mouse were investigated by Cross (1931, 1938) (*1, 2*), but his studies were confined to the spermatogonial chromosomes. The present study was made mainly on meiotic chromosomes. With the exception of *Peromyscus nasutus*, all species here reported show 24 chromosomes in the haploid set. *P. nasutus* has 26 haploid chromosomes. In all species there is always a heteromorphic XY-bivalent in the haploid complex, consisting of a large J-shaped X-element and a short rod-like Y. At metaphase the X and Y lie in side-by-side association coming together at their proximal dense part. The X and Y chromosomes disjoin at the first anaphase without exception. The diploid complement observed in 3 species shows 48 chromosomes, which consist of 2 pairs of large and medium J-shaped chromosomes, a pair of small V-shaped ones, together with rod-like elements.

The chromosomes of the muskrat (*Ondatra zibethica*) appear as rods, with the exception of a few chromosomes that have a constriction near their proximal ends. The chromosomes of the marmot (*Marmota flaviventris*) are characterized by J- and V-shapes of varying sizes. The prairie dog (*Cynomys ludovicianus*) shows also J- and V-shaped chromosomes varying in size. The diploid complement of the Mexican pocket mouse (*Liomys irroratus*) is remarkable in showing a pair of small J-shaped chromosomes together with rod-shaped elements of varying sizes. The porcupine (*Erethizon dorsatum*) is characterized by having the low number of 34 chromosomes in diploid cells, most of which are of J- or V-shape. The diploid complex of the chinchilla (*Chinchilla laniger*) shows chromosomes carrying submedian and subterminal centromeres, each one being a two-armed structure. The X chromosome is very prominent among the autosomes by being the largest V-shaped element. The Y comes next in size, also with a distinct V-shape.

TABLE 1

Chromosome Numbers of some American Rodents

Common name	Scientific name	Chromosome number		Sex chromosome
		2*n*	*n*	
Deer mouse (Cricetidae)	*Peromyscus polionotus polionotus*	—	24	X–Y ♂
	P. p. leucocephalus	48	24	"
	P. maniculatus maniculatus	48	24	"
	P. manic. blandus	—	24	"
	P. manic. bairdii	—	24	"
	P. manic. gambeli	—	24	"
	P. leucopus texanus	—	24	"
	P. truei truei	48	24	"
	P. nasutus	—	26	"
Muskrat (Microtinae)	*Ondatra zibethica*	54	—	"
Marmot (Sciuridae)	*Marmota flaviventris*	42	—	"
Prairie dog	*Cynomys ludovicianus*	52	—	"
Spruce squirrel	*Tamiasciurus fremonti*	—	25	"
Mexican pocket mouse (Heteromyidae)	*Liomys irroratus*	58	—	"
Porcupine (Erethizontidae)	*Erethizon dorsatum*	34	17	"
Chinchilla (Chinchillidae)	*Chinchilla laniger*	64	32	"

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Manuscript received July 31, 1953.

[1] Cordial thanks are due to T. S. Painter, M. J. D. White, W. F. Blair (University of Texas), L. R. Dice (University of Michigan), and W. H. Leonard (Colorado A. & M. College) for their kind assistance which enabled me to accomplish this work. Details will be published elsewhere with some additional data.

Comments and Communications

Starvation and Responsiveness of Some Laboratory Animals

BULLFROGS, in a recent shipment, were quite lethargic after storage and reacted only when they were strongly stimulated. It seemed possible that they were sluggish from starvation; therefore, they were injected with small amounts of a high concentration of glucose in Ringer's solution. The frogs staged a dramatic comeback. After a day, the screen lid of the tank in which they were kept had to be weighted down because of their vigorous hopping. It has been observed over many years that frogs are not readily induced to eat in the laboratory or even in outdoor tanks unless placed under conditions closely simulating nature. Prolonged starvation is therefore usually the result of storage. However, no tests were made to see whether the glycogen in the liver and muscle was depleted.

To get some idea of the degree of absorption of injected sugar, a series of graded injections was made and the urine was tested for overflow of glucose. Urine was accumulated in the bladder by superficially inserting a very fine insect pin on each side of the cloaca and tying the anal pore with thread. When a sample was desired the thread was released. After a number of trials, it was found that a 1.5-ml injection of 8% glucose into a 49-g grass-frog gave a positive test for reducing sugar in the urine in 1 hr. Tests for reducing sugar at various periods of time showed that about one-third of the sugar injected appeared in the urine within 7 hr, after which no more was voided. Undoubtedly, the amount of sugar absorbed depends upon the degree of starvation as well as upon the size of the animal. Presumably excess sugar is voided by the kidney, and therefore excessive amounts injected into frogs should not hurt them.

A somewhat similar observation was recently made with the sipunculid worm, *Phascolosoma agassizzi*. Proboscis retractor muscles excised from freshly collected worms served as excellent though small experimental objects, but after a few days of starvation, contractions of such muscles were visible only under a magnifier and were insufficient to lift a blade of grass used as a lever for marking the kymograph. Muscles excised several hours after injection of glucose into the body cavity of the worm showed considerably more vigorous contractions. This was particularly true if the muscles were stored overnight in 0.1% glucose in sea water at 5° C. The results are reported because they may remind others of the possible depletion of sugar reserves in various animals stored under unnatural conditions while awaiting use in classroom experiments and the decreased responsiveness which may be reversed by supplying glucose.

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Received September 28, 1953.

Radioactive Gold

IN the September 4, 1953, issue of SCIENCE, a brief communication appeared concerning "the danger of radioactive colloids" by Elemer R. Gabrieli of the Yale University School of Medicine. In this communication, reference is made to an article by Dr. Yuhl and myself (*Nucleonics*, 11, 54 [1953]), which concerned the development of a new technique for recording the anatomic configuration of the liver by means of intravenously administered radioactive colloidal gold (Au^{198}). This was an experimental study carried out on animals. In this article reference was made to instrument developments in this laboratory in an effort to reduce the quantity of radioactive gold to a safe level for human application. This work has been completed and the method applied to the diagnosis of space-occupying lesions of the liver in humans.

It should be emphasized that the dosage of radiogold used in this procedure does not exceed 300 microcuries, which in an average patient delivers less than 15.2 equivalent roentgens to the liver. The total body radiation from this tracer dose of Au^{198} is approximately 0.32 equivalent roentgens. The application of this procedure has been limited to those patients with known primary malignant neoplasms elsewhere in the body who are suspected of harboring hepatic metastases from such primary lesions. There has been absolutely no evidence of radiation injury to the liver or hemopoietic tissue in these patients following the administration of a single tracer dose of 300 microcuries of radiogold.

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Received October 1, 1953.

The Production of Heinz Bodies in Normal Human Erythrocytes by Metabisulfite

THE observation was previously made, and recently extended, that Heinz bodies formed in nonsickling erythrocytes of children and adults at pH 4.0 when exposed to a 2% aqueous solution of sodium bisulfite, prepared from reagent grade crystals or from 3 grain tablets of sodium metabisulfite.[1] The same results were obtained when 0.9% sodium chloride solution was used as the solvent (pH 3.6). These structures were not present when the wet mount was made, and appeared within the time limit (15 min) set for observing the sickling preparation. They were visible only at magnifications of 950–1000 ×, and were never seen within the sickled erythrocytes of patients with either sickle cell anemia or the sickle cell trait. No previous description of these changes could be found in the literature. The Heinz bodies went through the usual stages of formation at the periphery of the erythrocyte, coalescence, extrusion from the cell (with stalks),

[1] Supplied by Eli Lilly and Co.

and Brownian movement. This was followed by irregular linear distortion beginning at the central pallor and ending in incomplete red cell fragmentation.

These observations may be significant in further demonstrating the differences between the globin fractions of normal and sickle cell hemoglobins. It is now believed that Heinz bodies represent particles of denatured globin ("globan") (*1*). If so, their formation under the above conditions indicates a denaturing effect by the bisulfite on the intraerythrocytic globin. It has been assumed that the principal difference between normal and sickle cell globins lies in the folding or coiling of the polypeptide chains of the globin molecules (*2*). If this is so, it is conceivable that certain reactive groups (possibly —SH) in the normal globin molecule are available for combination with bisulfite (and subsequent denaturation of the globin), whereas the different molecular arrangement of the sickle cell globin does not lend itself to this reaction. Studies are now in progress to observe the effect of other reducing agents on this phenomenon and to determine whether quantitative differences are present in the reaction of erythrocytes from patients with sickle cell anemia as compared to those with the sickle cell trait.

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Received August 3, 1953.

Who Discovered Vitamins?

EVERY writer who has given an account of the earliest conception that essential nutrients for mammals, other than the "albuminous, saccharine, and oleaginous principles" comprehended in 1827 by Prout, states that N. Lunn (*1*) in 1880, while working in the laboratory of G. v. Bunge, at Dorpat, was the first to provide proof that unidentified dietary essentials must exist in milk. The basis for Lunin's statement was his observation that mice could remain in good health during at least 60 days when restricted to milk as their sole food, whereas, when given a mixture of casein, lactose, milk fat, and milk ash, in the same proportions as in milk, they speedily declined and died. He wrote: "Mice can live well under these conditions when receiving suitable food (e.g., milk), but as the experiments show that they cannot subsist on proteins, fats and carbohydrates, salts and water, it follows that other substances indispensable for nutrition must be present in milk besides casein, lactose, fat and salts."

The present writer believes that the first person actually to express this belief was the distinguished French chemist, J. A. B. Dumas. Ten years before Lunin wrote the statement quoted above, Dumas published a paper on "The Constitution of Blood and Milk," which was published in English translation in 1871 (*2*). In this paper he described the effects of substitute foods on the infants of Paris during the Siege. Here, for the first time in history, a distinguished scientist interpreted his observations on the experiences of human subjects, restricted through the pressure arising from the siege, to a diet as simplified, in chemical terms, as any rigidly controlled animal experiment. Dumas told of the extremity of the people in Paris when they ran out of "comestibles and combustibles." He said ". . . to the scarcity of milk and eggs, the certain cause of the premature decease of a great number of young children . . . and finally, to the exhaustion of the supplies of corn, flour and meat, which, rendering the capitulation of Paris inevitable, marked the precise day for it. . . . Scientific men were asked urgently to find ways for obtaining heat without combustibles; to reconstruct food with mineral materials, without the cooperation of life . . . to reproduce, at least the essential food of man with non-alimentary materials."

"Was it possible," he continued, "to come to the assistance of new-born children by replacing milk, which could no longer be got, by some saccharine emulsion? In this case there was no question of creative chemistry, but only of culinary chemistry. Recipes were not wanting, all reproducing an albuminous liquid with sugar and an emulsion of a fatty body. As a provisional succedanum this artificial milk deserved to be welcomed. But sometimes there was such a conviction in the authors of these preparations that one was forced to dread for the future of the effects of their faith. This was of a nature to make many proselytes, to the great injury of the children at nurse. . . . How could the latter [the milk dealers] have the least scruple when they were taught to manufacture an emulsion which they saw recommended to consumers, as the real equivalent of milk?"

The disastrous effects of feeding infants and young children on such emulsions led Dumas to say: "For these reasons, and many more, for no conscientious chemist can assert that the analysis of milk has made known the products necessary to the life which that aliment contains, we must renounce for the present, the pretensions to make milk, and especially to abstain from identifying any emulsion with this product."

So far as I am aware, the observations of Dumas appear never to have been mentioned by investigators of nutrition. They deserve recognition as the earliest conclusive demonstration that unrecognized nutrients exist, which before had found no place in the philosophy of physiologists and chemists, and were not to be again suspected of existence until, a decade later, Lunin recorded his eventful conclusions.

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Received October 12, 1953.

Book Reviews

Untersuchungen über die Tiergemeinschaften des Bodens: Die Oribatiden und ihre Synusien in den Böden Norddeutschlands. Karl Strenzke. *Zoologica,* Band 37, Heft 104, Stuttgart, 1952. 172 pp.

Because of the increasing realization of the importance of mites in relation to man and animals and agriculture, this publication is timely. It deals with the oribatid fauna of North Germany and is an outstanding contribution to the study of the role of mites and their relation to the soil.

Few people realize that among the dominant inhabitants of the upper layer of the soil are the tiny oribatid mites (Oribatei) which feed on litter, reducing it to usable organic matter. These mites are found by the thousands and, as Strenzke has pointed out, a study of the oribatid species is indispensable as a foundation for understanding the soil-biological processes in land and forest economy. Since populations are limited by ecological factors, the species can be used as indicators of soil condition. Two factors which regulate the distribution of a large number of species are the degree of humidity and the pH of the substratum. Strenzke has divided the soil into 6 major categories, each characterized by a dominant mite species. The oribatids include species that have been shown to be carriers for various tapeworms such as those found in sheep and other pasture animals.

With so little known about mites, this publication on their ecology, covering 240 species and subspecies of North Germany, with detailed notes and a complete bibliography, is a necessary tool for anyone interested in soils or arthropods, as well as for those interested only in the taxonomy of mites. It is hoped that more American workers will soon turn to the biological aspects of the Acarina, especially of this group so little known in our country.

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The Sulfapyrimidines. Lawrence H. Sophian, David L. Piper, and George H. Schneller. New York: A. Colish, for the Lederle Laboratories, 1952. 180 pp.

This book was compiled for the use of the practicing physician, and the last half is devoted to the general utility of the sulfapyrimidines, individually and as the triple-sulfa mixture, in the management of clinical infections. It should be a useful handbook in clinical practice. The first 90 pages, concerned with the history, chemical and physical properties, and mode of action of sulfa drugs, are of more interest to the research scientist. The pharmacology of these drugs, their absorption, metabolism, exeretion, and toxic effects, are discussed separately.

The sulfapyrimidines have been chosen as the subject of a monograph because of the belief that, in this series, the sulfa drugs have reached the highest possible degree of activity. Although there is good chemical and physiological evidence to back up this belief (for example, Bell and Roblin, *J. Am. Chem. Soc.,* 64, 2905 [1942]) these authors have not cited it. They have reported instead numerous tests on infected animals which show that these compounds are highly active, but do not necessarily imply that the peak of activity has been obtained.

In the first paragraph of the book, an interesting problem in semantics is raised by the statement "[No one] feels that the antibiotics are threatening to supersede chemotherapy." This implies that treating infections with antibiotics is not chemotherapy. If treating infectious diseases with natural products (antibiotics) differs from treatment with synthetic products (chemotherapy), what then is the process involved when synthetic chloromycetin is used?

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Visceral Circulation. A Ciba Foundation Symposium. G. E. W. Wolstenholme, Ed., with assistance of Margaret P. Cameron and Jessie S. Freeman. Boston: Little, Brown, 1953. 278 pp. Illus. + plates. $6.50.

This interesting volume contains the papers and general discussions of the symposium on visceral circulation held in London in July, 1951. In it are represented the efforts and the varied points of view of many internationally outstanding authorities in the field of the circulation. Composed of 25 scientific papers, together with the opening and closing remarks of symposium chairman J. McMichael, the book presents a many-sided approach to the general problem of circulation and introduces a wealth of techniques currently applied to its study in various tissues and organs.

The volume is logically divided into four parts, the first of which is devoted to anatomical studies of Visceral Vascular Architecture, opening with a general survey of visceral vascular structures by J. D. Boyd. Following this are four papers dealing in order with details of the vascular architecture of the alimentary canal, lungs, kidney, and liver. Throughout these presentations, attempts are made to correlate anatomical structure and functional activity.

Part II, dealing with General Factors in Blood Flow Regulation, opens with an excellent article of fundamental importance on the laws of physics and flow in blood vessels, by A. C. Burton. Discussing the problem of the relation between rate of blood flow and the pressure which drives it, Burton carries the reader from the early physical experiments of Poiseuille through his own ingenious biophysical investigations. Subsequent articles in this section are concerned with the roles of adrenaline, noradrenaline, and amine oxidase in the regulation of blood flow, and with pain perception by dilated visceral arteries.

In Part III, entitled Regional Blood Flow Regulation, are 11 of the 25 papers which comprise the book. In a sense it is an elaboration from a more physiological aspect of Part I. This is introduced by a scholarly résumé of afferent pathways of cardiovascular reflexes by D. Whitteridge, and a related account of reflex reactions evoked from lung receptors by G. S. Dawes. Following these are articles dealing with the regulation of blood flow in the aorta and coronaries, lungs, extremities, skin, kidney, ovaries and uterus, stomach and liver. Part IV contains four papers relating to the Interaction of General and Visceral Circulations. A highlight of this section is G. M. Bull's challenging consideration of possible mechanisms by which renal regulation of total body water is effected.

Although some of the papers in this volume are little more than summaries and others are highly speculative, the majority are of excellent quality, enhanced by the inclusion of carefully selected figures and references. Discussions are maintained at a high caliber throughout the book and provide much stimulating material for the thoughtful reader. Considered as a whole, *Visceral Circulation* constitutes a valuable and fascinating contribution to the current literature on the circulation. It leaves the reader with an acute awareness of the tremendous scope and complexity of the subject and an admiration for the worthy efforts of the investigators represented between its covers.

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Deformation and Flow in Biological Systems. A. Frey-Wyssling, Ed. Amsterdam: North-Holland Pub.; New York: Interscience, 1952. 552 pp. $11.50.

This volume is a collection of reviews on subjects not particularly related to each other, but most have something to do with either macroscopic or microscopic flow. A list of the reviews is as follows: The Rheological Properties of Protoplasm, Seifriz (153 pp.); The Rheology of Muscle, Pryor (36 pp.); Deformation of Plant Cell Walls, Frey-Wyssling (62 pp.); Movement of Water in Higher Plants, Preston (64 pp.); Latex Flow, Frey-Wyssling (21 pp.); Viscous Flow through Elastic Capillaries, Hermans (10 pp.); Rheology of Blood and Lymph, Bayliss (63 pp.); Cerebrospinal Fluid and Intraocular Fluid, Amsler and Huber (27 pp.); Secretions, Scott Blair (18 pp.); Diffusion Phenomena in Biology, Eggleton (14 pp.); and a report on the First International Colloquium on Rheological Problems in Biology (35 pp.).

The use of 153 pages of this volume for a review of the rheological properties of protoplasm would seem quite unjustifiable; the other articles are reasonably concise and bring together for discussion a good bit of physiological literature not ordinarily included in reviews.

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Scientific Book Register

Rudolph Virchow: Doctor, Statesman, Anthropologist. Erwin H. Ackerknecht. Madison: Univ. Wisconsin Press, 1953. 304 pp. + plates. $5.00.

Adrenal Cortex: Transactions of the Fourth Conference, November 12–14, 1952, New York. Elaine P. Ralli, Ed. New York: Josiah Macy, Jr. Fdn., 1953. 165 pp. Illus. $3.50.

A History of Astronomy: From Thales to Kepler. 2nd ed. Reissue. J. L. E. Dreyer. New York: Dover, 1953. 438 pp. Illus. $1.95; cloth, $3.95.

Problems in the Anatomy of the Pelvis: An Atlas. Eduard Uhlenhuth, with assistance of DeWitt T. Hunter; illus. by William E. Loechel. Philadelphia–London: Lippincott, 1953. 206 pp. Illus. $10.00.

Science and Fruit. Commemorating the Jubilee of the Long Ashton Research Station, 1903–1953. T. Wallace and R. W. Marsh, Eds. Bristol, Eng.: Univ. Bristol, 1953. 308 pp. Illus. + plates. $4.50.

Glacier Variations and Climatic Fluctuations. H. W. :Son Ahlmann. New York: American Geographical Society, 1953. 51 pp. Illus. $2.50.

An Introduction to Symbolic Logic. 2nd ed. Susanne K. Langer. New York: Dover, 1953. 367 pp. $1.60; cloth, $3.50.

Along the Great Rivers. Gordon Cooper. New York: Philosophical Library, 1953. 159 pp. + plates. $4.75.

Vergleichende Physiologie: Nervenphysiologie, Vol. II. W. von Buddenbrock. Basel: Verlag Birkhäuser, 1953. 396 pp. Illus. Sw. fr. 34.30; clothbound Sw. fr. 38.50.

Dislocations and Plastic Flow in Crystals. A. H. Cottrell. New York: Oxford Univ. Press, 1953. 223 pp. Illus. + plates. $5.00.

Communication: From Cave Writing to Television. Julie Forsyth Batchelor. New York: Harcourt, Brace, 1953. 116 pp. Illus. $2.50.

Experiments, Theory, and Problems in General Chemistry. Hosmer W. Stone and James D. McCullough. New York–London: McGraw-Hill, 1953. 352 pp. Illus. $6.00.

Fossil Plants of the Florissant Beds, Colorado. Harry D. MacGinitie. Washington, D. C.: Carnegie Inst. of Washington, 1953. 198 pp. + plates. $5.25; clothbound, $5.75.

Advances in Catalysis and Related Subjects, Vol. V. W. G. Frankenburg, V. I. Komarewsky, and E. K. Rideal, Eds. New York: Academic Press, 1953. 487 pp. Illus. $11.00.

Franz Boas. The science of man in the making. Melville J. Herskovits. New York–London: Scribner's, 1953. 131 pp. $2.50.

The Tools of Social Science. John Madge. London–New York: Longmans, Green, 1953. 308 pp. $4.75.

The Structure of Human Personality. H. J. Eysenck. London: Methuen; New York: Wiley, 1953. 348 pp. Illus. $5.75.

The Works of Archimedes and ***The Method of Archimedes.*** Reissue. T. L. Heath, Ed. New York: Dover, 1953. 377 pp. Illus. $1.95; cloth, $4.95.

How Animals Move. The Royal Institution Christmas Lectures 1951. James Gray. New York: Cambridge Univ. Press, 1953. 114 pp. Illus. + plates. $3.00.

Dislocations in Crystals. W. T. Read, Jr. New York: McGraw-Hill, 1953. 228 pp. Illus. $5.00.

Existential Psychoanalysis. Jean-Paul Sartre. Trans. by Hazel E. Barnes. New York: Philosophical Library, 1953. 275 pp. $4.75.

Publications Received

The Development and Present Status of the Trace Theory of Memory. *The British Journal of Psychology,* Monogr. Suppl. XXIX. Bronislaw R. Gomulicki. New York: Cambridge Univ. Press, 1953. 94 pp. $2.50.

Diphtheria and Pertussis Vaccination. Report of a conference of heads of laboratories producing diphtheria and pertussis vaccines. Technical Report Series, No. 61. 88 pp. 55¢. ***Expert Committee on Bilharziasis.*** First Report. T.R.S., No. 65. 45 pp. 30¢. ***Expert Committee on Influenza.*** First Report. T.R.S., No. 64. 32 pp. 20¢. Geneva: World Health Organization, 1953.

Essences Forestières et Bois du Congo: Introduction. Jean Louis and Joseph Fouarge. Brussels: L'Institut National pour l'Étude Agronomique du Congo Belge, 1953. 72 pp. + plates. 180 fr.

Etude de l'Homogénéité des Données Aérologiques dans une Partie du Réseau de l'Ouest de l'Europe. Publ. Series B, No. 7, 1953. L. Malet. 20 pp. Illus. ***L'Influence de la Force de Coriolis sur les Mouvements Atmosphériques.*** Contribs., No. 6, 1952. Paul Dedecker. 5 pp. Brussels: Institut Royal Météorologique de Belgique.

Falkland Islands Dependencies Survey: Scientific Reports. No. 1: *Organisation and Methods.* V. E. Fuchs. 12 pp. + 3 plates + appendices. 4s 6d. No. 2: *A New Method of Age Determination in Mammals with Special Reference to the Elephant Seal.* R. M. Laws. 11 pp. Illus. + plate. 3s. No. 3: *The Upper Cretaceous Cephalopod Fauna of Graham Land.* L. F. Spath. 60 pp. + 13 plates. 30s. No. 4: *Lower Cretaceous Gastropoda, Lamellibranchia and Annelida.* L. R. Cox. 14 pp. + 2 plates. 5s 6d. No. 5: *Fossil Penguins from the Mid-Tertiary of Seymour Island.* B. J. Marples. 15 pp. Illus. + 2 plates. 5s 6d. London: Her Majesty's Stationery Office, 1953.

Five Year Report and Current Projects. Cambridge 38, Mass.: Russian Research Center, Harvard University, 1953. 84 pp.

Fresh-Water Triclads (Turbellaria) of Alaska. Proc. U. S. National Museum, Vol. 103, No. 3322. Roman Kenk. 23 pp. Illus. ***Review of the Indo-Pacific Anemone Fishes, Genus Amphiprion, with Descriptions of Two New Species.*** Vol. 103, No. 3323. 17 pp. Illus. Washington, D. C.: Smithsonian Institution, 1953.

Handbook of Noise Measurement. Arnold P. G. Peterson and Leo L. Beranek. Cambridge 39, Mass.: General Radio Co., 1953. 102 pp. + appendices. Illus. $1.00.

Immature Stages of Indian Lepidoptera: Geometridae, No. 8. Indian Forest Records, Vol. 8, No. 7, Entomology Series. Balwant Singh. Delhi, India: Manager of Publications, 1953. 158 pp. Illus. 7s.

Keeping Our Hospitals Operating. A study of supply and equipment requirements. Public Health Service Pub. No. 272. Washington, D. C.: U.S. Department of Health, Education, and Welfare. 185 pp.

Report of the Medical Research Council for the Year 1951–1952. Committee of Privy Council for Medical Research. London: Her Majesty's Stationery Office, 1953. 241 pp. 6s 6d. or $1.50.

River Basin Surveys Papers. Inter-Agency Archeological Salvage Program, Nos. 1–6. Smithsonian Institution, Bureau of American Ethnology, Bull. 154, 1953. Order from Government Printing Office, Washington 25, D. C. 336 pp. Illus. + 56 plates. $1.75.

Scientific Research as It Proceeds in Mellon Institute, 1952–1953. Annual Report Series, No. 40. Pittsburgh: Mellon Institute, 1953. 52 pp. Illus.

Meetings & Conferences

Dec. 1–4. American Medical Association (Clinical). St. Louis, Mo.
Dec. 1–4. Corrosion Conference. Oklahoma City, Okla.
Dec. 2–3. Animal Care Panel (4th Annual). Chicago, Ill.
Dec. 2–4. Mid-Century Conference on Resources for the Future. Washington, D. C.
Dec. 3–5. Florida Academy of Sciences. Winter Park, Fla.
Dec. 3–5. Symposium on B-Vitamins. Austin, Tex.
Dec. 3–6. American Psychoanalytic Association. New York, N. Y.
Dec. 4–5. Oklahoma Academy of Science (Annual). Langston, Okla.
Dec. 5. American Alpine Club. New York, N. Y.
Dec. 5–8. American Academy of Optometry (Annual). Chicago, Ill.
Dec. 6. American Academy of Dental Medicine. New York, N. Y.
Dec. 6–8. Chemical Specialties Manufacturers Association (40th Annual). Washington, D. C.
Dec. 6–9. American Society of Refrigerating Engineers. Washington, D. C.
Dec. 7–9. American Society of Agricultural Engineers (Winter). Chicago, Ill.
Dec. 7–9. Entomological Society of America. Los Angeles, Calif.
Dec. 9–11. Western Forestry Conference (44th Annual). Seattle, Wash.
Dec. 10. British Columbia Academy of Science. Vancouver, Canada.
Dec. 10–12. Southern Association of Science and Industry. New Orleans, La.
Dec. 13–16. American Institute of Chemical Engineers. St. Louis, Mo.
Dec. 13–18. Radiological Society of North America (Annual). Chicago, Ill.
Dec. 17–22. Inter-American Society of Psychology (1st). Ciudad Trujillo, Dominican Republic.
Dec. 17–22. International Conference on Low Temperature Physics (3rd). Houston, Tex.
Dec. 26–31. AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Boston, Mass.
Dec. 27–28. American Folklore Society. Tucson, Ariz.
Dec. 27–30. American Astronomical Society. Nashville, Tenn.
Dec. 27–30. Econometric Society. Washington, D. C.
Dec. 27–30. American Statistical Association. Washington, D. C.
Dec. 27–30. Institute of Mathematical Statistics. Washington, D. C.
Dec. 28–29. Linguistic Society of America. New York, N. Y.
Dec. 28–30. American Anthropological Association (Annual). Tucson, Ariz.
Dec. 28–30. American Philosophical Association. Rochester, N. Y.
Dec. 28–30. American Economic Association. Washington, D. C.
Dec. 28–30. Archaeological Institute of America. New York, N. Y.
Dec. 28–30. Western Society of Naturalists (Winter). Los Angeles, Calif.
Dec. 28–31. American Mathematical Society. Baltimore, Md.
Dec. 29–30. Oregon Academy of Science (Annual). Portland, Ore.

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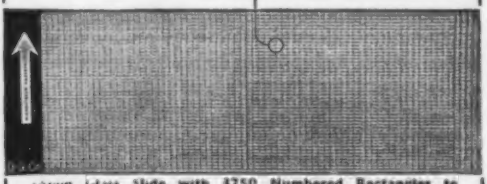

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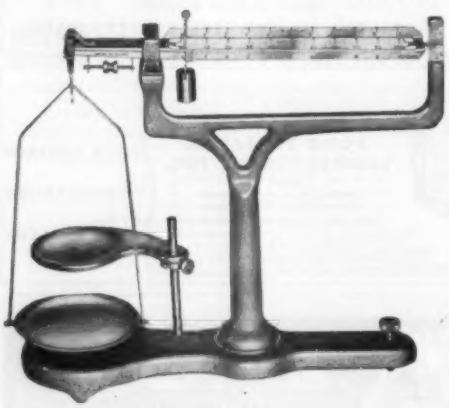

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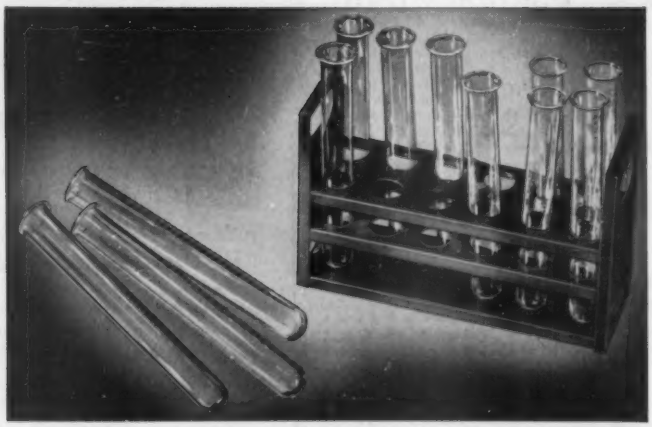

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